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Documentation and evaluation of comparability of overhead costs reported for depot level maintenance.

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

DOCUMENTATION AND EVALUATION OF
COMPARABILITY OF OVERHEAD COSTS
REPORTED FOR DEPOT LEVEL MAINTENANCE

by

William Thomas Parker

December 1984

Thesis Co-advisors: K. Euske
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The analysis in this study is based on information obtained from on-site visits to Naval Air Rework Facility, North Island and Ogden Air Logistics

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Documentation and Evaluation of Comparability of Overhead Costs Reported for Depot Level Maintenance

by

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I. INTRODUCTION

A. THESIS OBJECTIVE

The purpose of this research project is to examine and document the handling of overhead and indirect costs by the various Services for depot maintenance operations. The degree to which data collected fulfill the requirements of Department of Defense (DOD) uniform cost accounting as set forth in the Cost Accounting and Production Reporting Handbook (DOD 7220.29H) is explored.

A key objective of 7220.29 is the ability to make efficiency comparisons between activities, Services, and commercial enterprises engaged in similiar work. Overhead costs represent some 30 to 50 percent of total depot maintenance costs and, in general, suffer reduced visibility and causality link with the end product compared to direct inputs. Given these two factors, some comparison of indirect to direct factors of production appears to merit exploration as a means of measuring relative efficiency. Therefore, this study focuses on the specific ability of the existing systems to provide useful indirect to direct efficiency comparisons between activities, Services, and commercial enterprises. Time constraints preclude review of all Services. The Navy job order cost system and the Air Force process cost system were chosen for review.

B. HISTORY OF THE PROBLEM

The lack of a uniform cost accounting system is a long standing problem within DOD. Efforts to implement such a system date back to 1963 when DOD 7220.14, "Uniform Cost Accounting for Depot Maintenance", and DOD 7220.9, "Depot Maintenance Production Reporting", were published. The provisions of these two directives were subsequently consolidated in 1968 and promulgated as DOD 7220.29, "Uniform Depot Maintenance Accounting and Production Reporting System", under the joint sponsorship of the Assistant Secretary of Defense, Comptroller (ASD(C)) and the Assistant Secretary of Defense, Installations and Logistics (ASD(I&L)) - - since redesignated Manpower, Installations and Logistics (MI&L). In accordance with the Budget Act of 1950, which requires accounting systems of federal agencies to comply with the principles and standards promulgated by the Comptroller General, the instruction was submitted to the Government Accounting Office (GAO) for review and approval. After lengthy review, including review of actual procedures at various Army, Navy and Air Force depot maintenance activities, GAO advised the Secretary of Defense (SECDEF) that approval would be withheld. The primary basis for non-approval was the lack of data reliability caused by lack of integration with a controlled accounting system [GAO, January 1971]. In a subsequent report to Congress, GAO further cited the lack of specificity of the existing instruction which resulted in varying interpretation, the lack of coverage of existing cost practices, and a lack of enforcement by DOD and recommended that DOD issue instructions and establish a monitoring system which would ensure the completeness, accuracy, comparability of

the data provided by depot maintenance cost accounting systems [GAO, February 1971]. In an effort to implement this recommendation, ASD(MI&L) chartered the Joint Logistics Commanders (JLC) panel to develop and promulgate a depot maintenance cost accounting manual providing more definitive guidance for a cost accounting system. This effort led to issuance of DOD 7220.29H, "Department of Defense Depot Maintenance and Maintenance Support Cost Accounting and Production Reporting Handbook" in October 1975. [Jivatode, July 1977]

Specific objectives of the system were as follows:

1. To establish a uniform accounting system for use in accumulating the costs of depot maintenance activities as they relate to the weapon systems supported or items maintained. This information would enable managers to compare unit repair costs with replacement cost.

2. To assure uniform recording, accumulating, and reporting on depot maintenance operations and maintenance support activities so that comparison of repair costs can be made between depots and between depots and contract sources performing similar maintenance functions.

3. To assist in measuring productivity, developing performance and cost standards and determining areas for management emphasis, which would enable managers to evaluate depot maintenance and maintenance support activities for efficient resource use.

4. To provide a means of identifying maintenance capabilities and duplication of capacity and indicating both actual and potential areas for interservice support of maintenance workload. [GAO, May 1978]

While an implementation date of October 1, 1976 was established by the instruction, significant differences between existing systems in each Service and the new system made meeting this target problematic. To aid in resolving these differences and monitoring implementation, an ad hoc group was formed by JLC Aeronautical Depot Maintenance Panel. Working under a temporary charter which was fulfilled by December 1979,

the group identified 28 areas of basic accounting disagreement in 15 Joint Interpretative Issuances (JII) and recommended 95 changes to DOD 7220.29H. While the group was highly successful in negotiating a reconciliation of the DOD and Service positions during its existence, 18 areas of DOD guidance were identified in a May 1981 Defense Audit Service (DAS) report as unimplemented by one or more Services. In March 1980, the JLC Aeronautical Depot Maintenance Action Group (JADMAG), was formed under a permanent charter to study ongoing problems with system implementation and operation. [DAS, April 1981]

While considerable effort has been expended to date to implement an uniform cost accounting system capable of meeting DOD management objectives, significant reporting discrepancies continue to exist which minimize the current value of the reports ("Maintenance Cost and Production Report (RCS DD-M(A) 1397)") generated from the data base. [Tackett, June 1984; Burnett, June 1984] Efforts to resolve interservice accounting system differences have resulted in implementation of a majority of those changes not requiring a major restructuring of existing systems. However, basic system differences (i.e., NIF accounting based on two verses three levels of indirect cost accumulation and allocation and the Air Force's use of a process verses a job order cost system) which would require significant restructuring of both the cost and financial accounting systems continue to exist. These basic system differences inhibit direct interservice cost comparability. A positive aspect of the situation within the Navy is the effort by Naval Air Logistics Command (NALC) to develop and install a common NAVAIR Industrial Fund System during FY85. While this

initiative represents a major move toward uniformity of data between activities within the activity group, the proposed system does not correct major structural differences with the DOD standard such as the number of levels of indirect cost accumulation and allocation. [Hawkins, October 84] In a similiar manner, the existence of a centrally controlled ADP application package at each Air Logistics Center (ALC), ensures compatability and comparability of data between ALCs. However, the package accumulates data on a process basis contrary to DOD 7220.29H. [Dix, October 1984]

The report begins with a brief overview of the aviation depot maintenance systems in order to establish the organizational and environmental background within which NARF, North Island and Ogden ALC operate. In a more specific vein, the study then briefly discusses the organizational and management systems in place at each activity. With the operating environment defined, the third section discusses the individual activity cost accounting systems from which Depot Maintenance data is extracted. Deviations from DOD 7220.29H are noted with regard to overhead and indirect costs and analyzed with regard to potential impact on DOD objectives. Where significant, alternatives are explored. The final section summarizes major findings and conclusions and offers recommendations for solving specific problems.

The results of this study are a part of a larger study to evaluate depot level reporting to the Office of the Assistant Secretary of Defense for Manpower, Installation and Logistics. As such, this and other concurrent studies are an elaboration on earlier studies performed at the Sacremento Air Logistics Center, Sacramento,

California [Gorris, June 1984], the Naval Air Rework Facility, Jacksonville, Florida [Burnett, June 1984], and the Sacremento Army Depot, Sacremento California [Tackett, June 1984].

II. THE DEPOT MAINTENANCE SYSTEM

A. SCOPE OF AVIATION DEPOT MAINTENANCE

Within DOD, maintenance is accomplished at three levels of increasing depth and performance capability. The lowest level, operational, is performed routinely by the asset user and is primarily preventive with some repair through minor component replacement. Intermediate maintenance, provides enhanced capability for component and assembly repair, replacement and calibration. Major system replacement, repair or reconditioning requiring significant technical expertise and industrial type facilities are reserved for depot maintenance. The depot maintenance facilities may be government owned and operated (GOGO) as are the six NARF's and five ALC's or, in keeping with governmental commercial/industrial (CI) initiatives, may be government owned and contractor operated (GOCO) or owned and operated by a contractor (COCO). Together, organizational (O), intermediate (I) and depot level maintenance provide a flexible, integrated maintenance capability well suited to the mobile environment within which DOD elements operate.

DOD Directive 4151.16, which is the source document for DOD maintenance guidance, defines depot maintenance as

> ...maintenance which is the responsibility of and performed by designated maintenance activities, to augment stocks of serviceable material and to support Organizational Maintenance and Intermediate Maintenance activities by use of more extensive shop facilities, equipment, and personnel of higher technical skill than are available at the lower levels of maintenance. Its phases normally consist of inspection, test, repair, modification, alteration, modernization,

conversion, overhaul, reclamation, or rebuild of parts, assemblies, subassemblies, components, equipment end-items, and weapon systems; the manufacture of critical nonavailable parts; and providing technical assistance to intermediate maintenance organizations, using and other activities.

In addition, performance of organizational or intermediate level maintenance functions by a designated depot maintenance activity is classified as depot maintenance.

Overall guidance for aviation maintenance within the Navy is contained in OPNAVINST 4790.2B, The Naval Aviation Maintenance Program (NAMP). Volume 4 of OPNAV 4790.2B provides specific guidance for depot level maintenance. Specific major program categories supported by the Navy depot maintenance function include:

1. Air frame rework under the Standard Depot Level Maintenance (SDLM) concept.
2. Modification of airframes, engines, and aircraft components and systems.
3. Repair and retrofit of improvements to aircraft engines.
4. Repair and overhaul of aircraft components and systems.
5. Manufacturing of designated parts, including the design and production of authorized equipment modification kits.
6. Aircraft support service functions, including such items as overhaul and repair of Ground Support Equipment (GSE), calibration of test equipment, and aircraft salvage.
7. Miscellaneous related programs including shipboard work, missile component repair, installation of capital equipment, and Navy engineering support. [OPNAVINST 4790.2B]

Within the Air Force, overall maintenance guidance is provided by AFLC Regulation 66-9, Equipment Maintenance DMS, AFIF Operating Procedures. While the scope of services supported by the aviation

depot maintenance programs within the Air Force and Navy are similar, differences in the command structure and the division of logistic and acquisition responsibilities between the two Services have implications for the availability and comparability of general base support cost data.

As depicted in Figure 2.1, the Navy's logistics function is subdivided by program (i.e., Aviation, Ships, Electronics, Facilities, Supply) and assigned to a System Command for management. Integration of the overall effort occurs only at the NAVMAT level. Within a System Command, the acquisition and maintenance function are integrated at the System Command level with maintenance support provided by a number of geographically dispersed maintenance activities. The supply support function is the responsibilty of NAVSUP and is carried out by way of a seperate organizational chain extending down to the regional Naval Supply Centers. The independence of organizational units at the local base level complicates the coordination and communication effort required to support the "full cost" concept required by DOD 7220.29H.

As depicted in Figure 2.2, the total logistics function in the Air Force is integrated under the management of the Air Force Logistics Command (AFLC). Directorates for each logistics functional area are reflected in the organizational structure from top to bottom. Therefore, the maintenance and supply support function are integrated at the Air Logistic Center level. However, acquistion responsibility is segregated and assigned to the Air Force System Command. Integration of the the logistics and acquistion function occurs at the Air Staff level and is supported by the efforts of the Aquisition

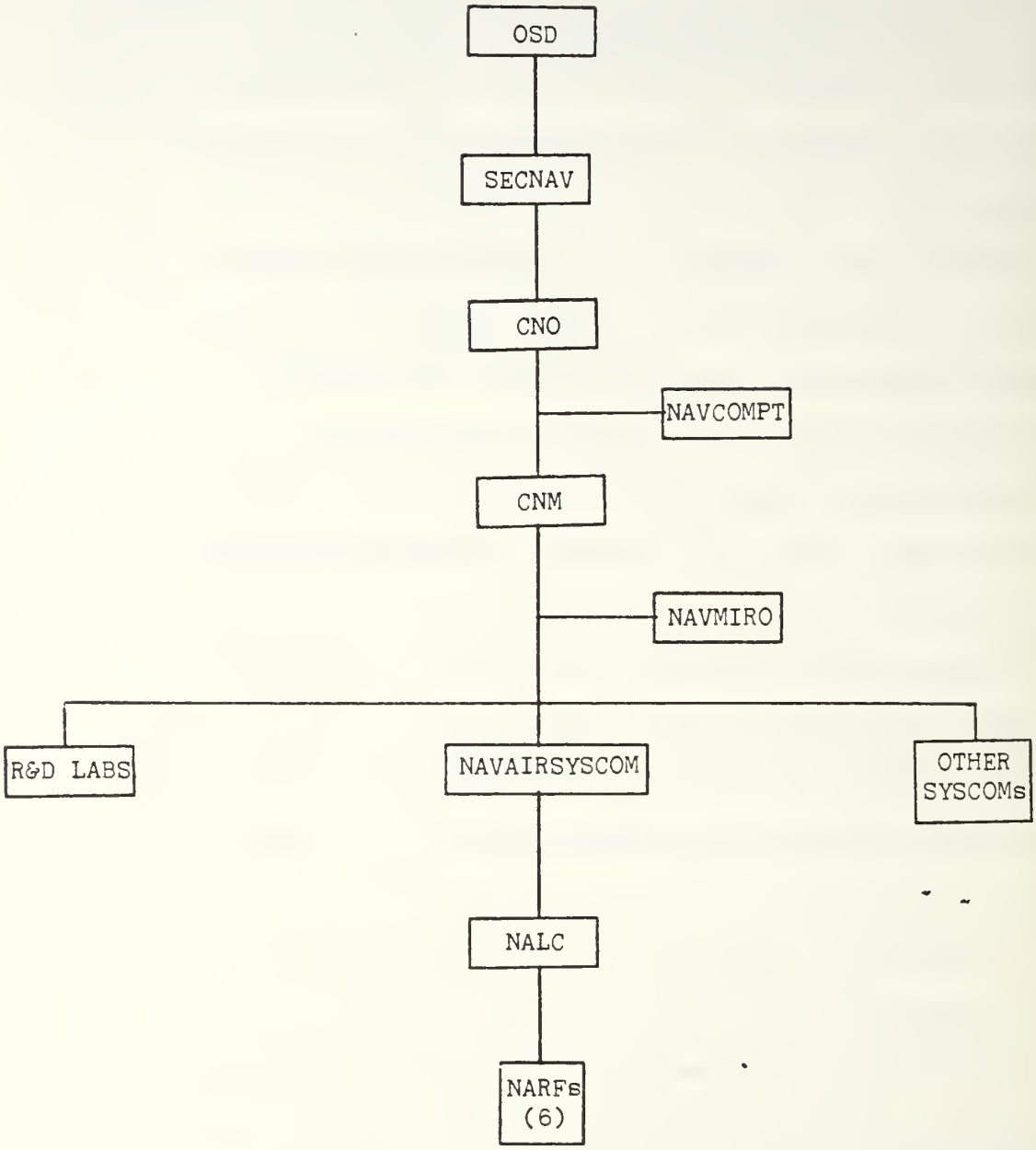

Figure 2.1: Depot Maintenance Command Hierarchy

Source: Adapted from OPNAVINST 4790.2B of 1 July 1979

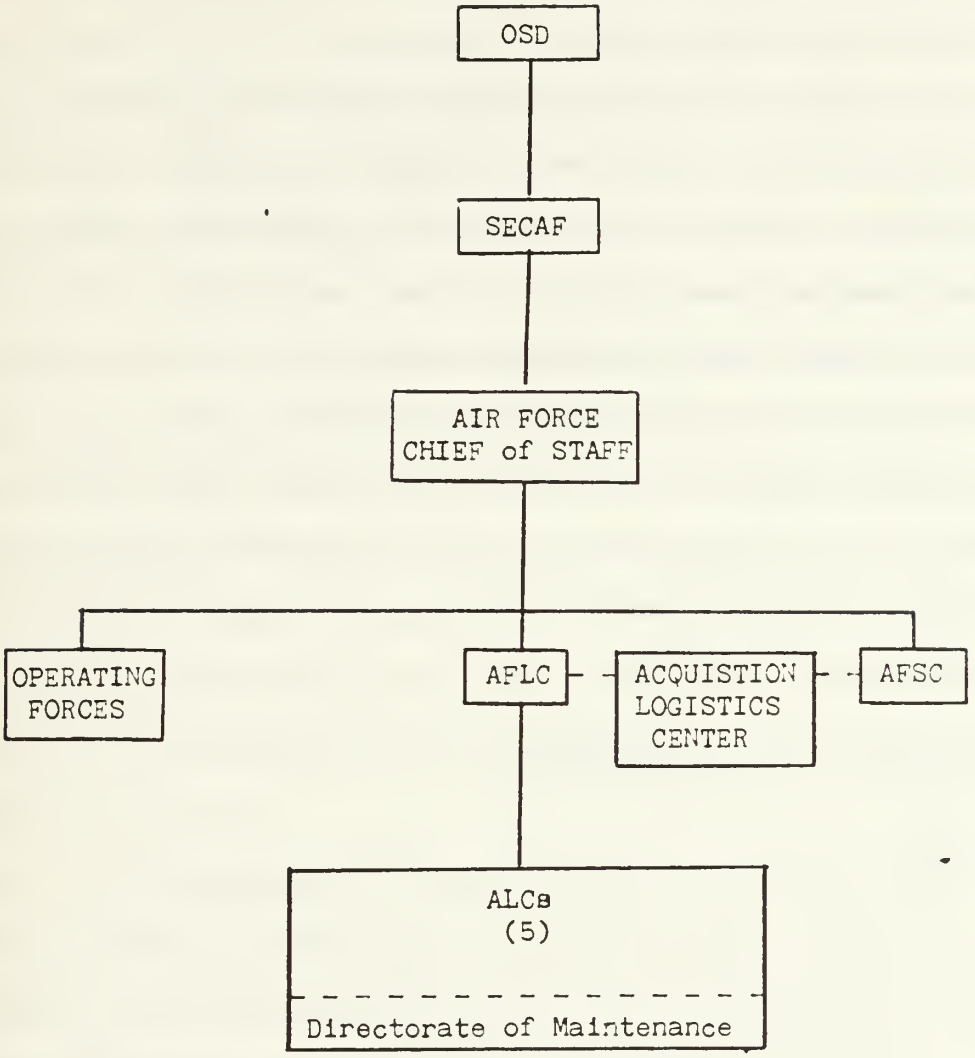

Figure 2.2: Air Force Depot Maintenance Command Hierarchy

Source: COL. Sabin, J., Interview, Head of Resource Management Division, Directorate of Maintenance, Ogden ALC, 26 October 1984

Logistics Center [Col. Sabin, October 1984]. With integration of the total spectrum of base operations and support functions at the local ALC level, potential interface barriers to ready availability of base support cost data are reduced.

In the Air Force, responsibility for depot level maintenance is distributed under a Technology Repair Center (TRC) concept. Under this concept, each of the five ALCs is assigned worldwide responsibility for the repair, overhaul, maintenance, analysis, and technical development of assigned weapon systems, equipment, components and devices. This specialization of each ALC in specific systems and components differs with the Navy's system. The Navy NARFs operate on a total weapon system basis (i.e., the F14 and all related components) and share major weapon system maintenance responsibility between designated east and west coast NARFs.

B. MANAGEMENT OF DEPOT MAINTENANCE

1. Navy

The Chief of Naval Material (CNM) is responsible to the Chief of Naval Operations (CNO) for overall management of the Navy depot maintenance program. Under this charter, CNM develops and promulgates, with staff support from the Deputy Chief of Naval Material (Operations and Logistics) and the Naval Material Industrial Resources Office (NAVMIRO), the broad policies and procedures for conduct of depot maintenance within the Navy. Within the specific area of aviation depot maintenance, responsibility is delegated to the Naval Air Systems Command (NAVAIRSYSCOM) for resource planning and budgeting and

oversight of program execution. This charter is executed via the Commander, Naval Air Logistics Command (NALC), who is responsible to NAVAIR for the actual implementation, coordination, management and administration of all Department of the Navy (DON) aviation depot maintenance programs. Within NALC, the Depot Maintenance Directorate serves as the functional manager of the NARFs and the Aviation Depot Level Maintenance program. As such, the Directorate's responsibilities include maintenance of the aviation depot maintenance five year plan, preparation of the depot maintenance Program Objectives Memorandum (POM) input, determination of source assignments, development of workload assignment plans and the monitoring of the performance of DON aviation depot maintenance by any performing agency. The six NARFs, as the primary performance agencies, form the final link in the DON management responsibility hierarchy. Command relationships and organizational hierarchy are depicted graphically in Figure 2.1. [OPNAVINST 4790.2B]

Financially, the NARFs form a segment of the Navy Industrial Fund (NIF) and are organized as an activity group under NAVAIR. The Comptroller of Navy (NAVCOMPT), as the CNO's designated agent for financial matters, provides overall NIF management guidance. To this end, accounting policy and procedure applicable to all NIF activities are promulgated in Volume 5 of the Navy Comptrollers Manual (NAVCOMPT Manual). As required, Activity Group Commanders prepare supplemental guidance appropriate to a specific activity group's operation which are promulgated under NAVCOMPT sponsorship as an activity group handbook.[Practical Comptrollership, July 1983] In the case of the

NARFs, the decision has been reached to rescind the NARF handbook leaving the NAVCOMPT Manual as the sole authoritative source of guidance for NIF accounting within the NARFs [Brinlee, August 1984]. The NIF accounting system incorporates double-entry, accrual accounting, and job order based cost accounting records integrated with the general ledger accounts.

To meet program management responsibilities, the NALC depends on a number of financial and operational performance reporting systems. Primary management tools available include the NIF Budget and Navy Industrial Fund Reporting System, the Production Performance Report System, and the Key Performance Indicator System.

The NIF A-11 Budget is input annually into the Navy Industrial Fund Reporting System (NIFRS) by each NARF based on workload inputs provided by NALC. From projected direct hours and estimates of expected costs to be incurred in workload accomplishment, projected statements of operating results (income statement) and financial condition (balance sheet) are developed. From this data, stabilized rates are developed and adjusted to achieve a zero accumulated operating result at the activity group level. Supporting the A-11 submission is the NIF Funding Budget which provides detailed production and related overhead expense budgets with cost breakdowns by program and Type, Model, Series (TMS). Program growth is separately identified using inflation factors developed by the Commerce Department and promulgated by OMB. Any real growth, particularly in the indirect cost area, is subject to close scrutiny by NALC during the budget review and stabilized rate development process. As such the system provides for

close control over increased costs within an existing program. The NIF Funding Budget also serves as a cost control and performance monitoring tool at both the NALC and activity level. Actual performance (manhours and resultant revenues and costs by program and TMS) is reported monthly against budget. Quarterly inputs are made in the form of formal Financial and Cost Statements which also feed the NIFRS. [Hawkins, October 1984]

Operational reporting systems include the three section Production Performance Report (PPR) and a series of 13 key indicators reported monthly on a cumulative basis.

The thirteen key indicators listed in Table 2.1 provide significant data on performance with actual performance reported monthly on a cumulative basis. Specific goals are not formally established annually for each area. Instead, broad criteria as to acceptable ranges exist and are used in development of operating plans and budgets with significant trends or variance from plan reflected in the indicators forming the basis for management action. [Hawkins, October 1984]

Detailed performance reporting is provided for by the PPR. Section A (Schedule and Completions) and Section C (Summary, Program, Manhours, Cost and Supplemental Information) are submitted to NALC and NAVAIRSYSCOM on a monthly basis. Section B (Production, Manhours, and Cost) is submitted on a quarterly basis. These reports permit analysis and evaluation of operations and encourage effective management by integrating the results of efforts in the areas of budgeting, performance analysis and production performance. [Burnett, June 1984]

Table II - I

KEY PERFORMANCE INDICATORS

Treasury Cash
Activity Cash
Materials and Supplies
Accumulated Operating Results
Labor Hours
  Regular Direct
  Overtime Direct
  Regular Indirect
  Overtime Indirect
Productive Ratio
Total Costs
Revenue
Personnel on Board
  Full Time Permenant
  Temporary

Source: Naval Aviation Logistics Center Letter 810/7000/17238 of 17 October 1983.

2. Air Force

Guidance for performance of depot maintenance in the Air Force is contained in AFLC Regulation 66-9, Equipment Maintenance DMS, AFIF Operating Procedures. Broad policy guidance is developed at the Air Staff level with specific maintenance policy guidance and execution monitoring responsibility vested in the Air Force Logistics Command (AFLC). The Acquistion Logistics Center provides staff support to and coordination of logistic and acquistion programs controlled by the AFLC and Air Force System Command (AFSC) respectively. Execution of maintenance and logistic support programs is the responsibility of the five ALCs within their designated system/program areas of responsibility. Specific responsibility for the execution of designated depot maintenance functions is vested in the Directorate of Maintenance at each ALC. [Col. Sabin, October 84].

Financial guidance for operation of the depot maintenance function within the framework of the Air Force Industrial Fund (AFIF) is provided by AFLC Regulation 170-10, Depot Maintenance Service, Air Force Industrial Fund (DMS, AFIF) Financial Procedures. In a manner similar to the NARFs, the ALCs annually develop a detailed operating budget based on projected workload. Operating results are projected and a rate structure developed for review and adjustment by AFLC to achieve a net zero operating result for the activity group. As in the Navy system, separate identification of real program growth by function combined with a requirement for detailed justification of growth in the indirect cost areas provides an effective control of cost growth in existing programs in these areas. Unlike the NARFs which develop stabilized rates for labor skill groups, the stabilized rates developed by the ALCs are for performance of a specific maintenance/maintenance support function. As such, the rates include recoupment factors for direct material as well as direct labor and overhead/indirect costs. Reporting requirements in support of AFLC financial management of AFIF at the ALCs are summarized in Appendix A which is an extract from AFLCR 170.10. [Creed, October 1984]

In addition to the purely financial management reports, the AFLC has developed the Maintenance Meaningful Measures of Merit (Maintenance 3M's) reporting system depicted in Appendix B. The system monitors 113 specific performance measures which are assigned relative weights and summarized into eight key performance area or "pulse point" indicators. Quarterly and monthly reports combined with weight factors for each element provide an integrated evaluation of total function performance. [Creed, October 1984]

C. NARF NORTH ISLAND

1. Activity Background

NARF North Island is one of six government owned and operated industrial activities forming the core of the naval aviation depot maintenance capability. The facility occupies 362 acres of land and 77 existing buildings, located at the Naval Air Station, North Island. These facilities provide approximately 2.6 million square feet of total covered area which includes 1.48 million square feet of industrial shop space. Productive shop space is further augmented by an additional 320 thousand square feet of outdoor shop space. [Command Presentation, 1984]. The plant and associated capital equipment currently installed are valued at approximately 92.2 million dollars. NARF North Island is staffed and operated by 29 military personnel and approximately 5500 government civilian employees, making the activity the largest of the NARFs.[Navy Industrial Fund Financial And Cost Statements, June 1984]

The facility began operation on July 15, 1919 as the Aviation Repair Facility of NAS North Island. With establishment of the industrial funded depot maintenance system, the activity became a NIF activity in 1962 and was redesignated NARF North Island in 1967 [Poland, December 1984]. Innovative and revolutionary changes in aviation technology during the commands existence have resulted in increasing technical sophistication of the units overhauled. The F14's, F4's, E2's and H46's overhauled today are a far cry from the fabric covered biplanes originally overhauled. However, the activity has kept pace as demonstrated by its designation as the overhaul point for the Navy newest aircraft, the F18. [Brinlee, August 1984]

2. Organization

NARF North Island is functionally organized into production and support activity elements similar to that found at the previous NARF visited [Burnett, June 1984]. Primary differences, as depicted in Figure 2.3, are the movement of the Material Department from Production to Management Services and inclusion of the Flight Check Department in the Quality and Reliability Assurance area. Other organization aspects, such as the breakdown into Command and Top Management elements, the integrated mix of civilian and military management expertise and the scope of responsibilities, discussed in detail in Chapter II of the June 1984 thesis by LCDR Burnett are equally applicable to NARF North Island.

3. Management Systems

The NIF Funding Budget, previously discussed with regard to management at the NALC level, serves as an operating budget at the activity level and is a key management control tool. It is, however, but one part of an integrated group of computer based systems for collection, manipulation, and reporting of the financial and performance information necessary to effective management control. A detailed description of the NARF North Island Management Information System is contained in NAVAIRREWORKFACINST 4854.2D. Major components of the system include:

a. Master Data Record (MDR) File Maintenance.
The MDR is the data base which contains the detailed engineering data required to route and rework material at the component, sub-component, and piece levels. Data from the MDR is a primary input into the Operating Document application. Inputs are made manually by Operations Analysis personnel to revise or expand the data base. In addition, data received from Inventory Control

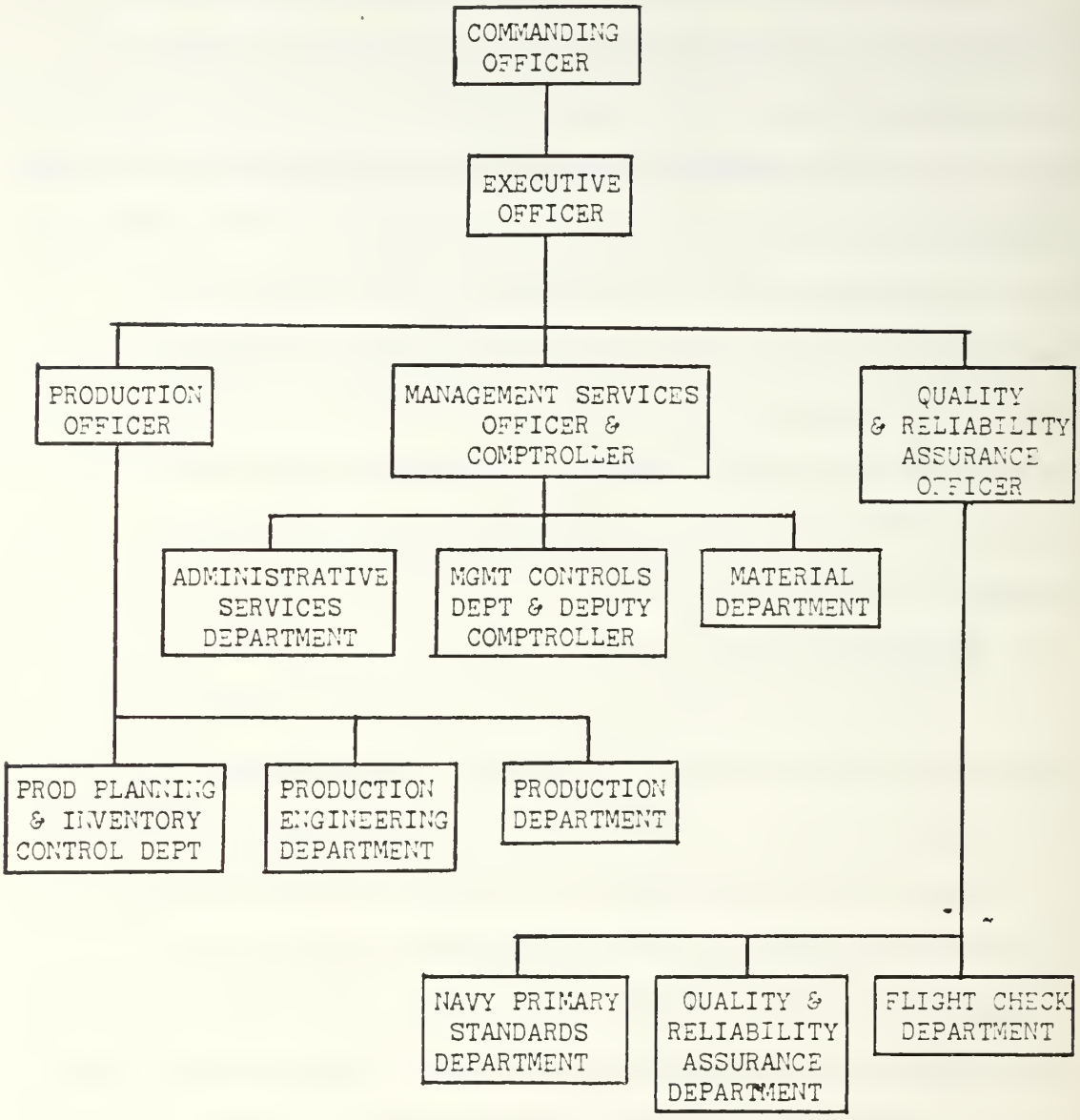

Figure 2.3: NARF North Island Organization Chart

Source: Extracted from NARF North Island Command Presentation, 1984

Points (ICP) in the form of a Quarterly Family Tape (QFT) update from the Aviation Supply Office (ASO) and weekly ICP change notices from other activities are input automatically.

b. Operating Documents (OPDOCS).
The OPDOCS system is a major element in work control and scheduling as well as providing the basis for accumulation of actual performance data for comparison with standards or estimate. The system provides for the preparation of necessary documentation to identify work requirements and process an item through the appropriate shops for work performance. The system creates a work in process record each time an OPDOC is generated for an item or group of operations. Primary inputs include data from the MDR file, Master Application Code File, Technical Directive File, Master Schedule File, Workload Data Cards, Schedule Changes, Manual Overides, and Special Induction Records. The OPDOC system possesses the capability to tailor the OPDOC to a specific aircraft bureau number or engine type and model.

c. Feedback.
The Feedback system processes recorded labor and work element transaction data and generates management reports. The primary source of inputs is the Source Data Automation (SDA) collection system which consists of specialized computer input terminals, called transactor stations, located in each work center. Data input by transactor includes employee identification and link and line number data from the OPDOC to identify the specific task and item being worked. In addition, capability exists for manual input of other information such as handwritten shop orders, labor corrections, and planner changes. Data processed by this system provides inputs to payroll, labor distribution, quality control and other production related areas.

d. Bill of Essentials.
This system collects and processes requisition data for material used in support of work programs. Availability of essential bits and pieces is determined prior to scheduling an item for work and input to the master file. Use of data from the master file by the Weekly Induction Scheduling (WIS) system results in allowance or inhibition of induction based on bit and piece availability.

e. Financial.
This system processes labor, material, and other expenditure data collected by other applications with adjustments and prorations against specific job orders or expense accounts. Job order costs are maintained in a master file after the initial transactions have been validated and recorded against the job order at the shop level. Financial costs are recorded by direct and indirect charges to expense accounts. NIF and cost reports are generated at frequencies ranging from daily to quarterly with summaries by job order within cost center by program. Primary uses of these

reports include budget planning and execution monitoring, customer billings, and financial management and cost control at various management levels starting at the cost center level. Figure 2.4, reproduced from NAVAIREWORKFACINST 4854.2D Volume 7, depicts the interrelationships of the financial system.

f. Weekly Induction Scheduling
This system supports component work scheduling. ICP requirements are input and an optimum induction schedule developed, given the priority of the requirement, availability of carcasses and repair materials, and availability of required trade skill hours and facilities.

g. History.
This system maintains a history of productive activity for each routed work item at the operation level. Outputs from the system include updates of occurence factors in the MDR and a statistical history of productive activity for management planning purposes.

h. Computerized Workload Projection and Budgeting System (CWPABS).
This system provides management with quarterly workload plans and funding budgets based on projected workloads developed at workload conferences. The workload subsystem distributes and balances projected manhours at the cost center level and then distributes these manhours to direct allocations and computes required overtime hours. The financial subsystem develops labor, material and overhead rates and prices out the planned workload.

i. Production Status.
The group of computer programs forming this system accumulate and report data applicable to the repairable component program. Master files maintain data at the National Stock Number (NSN) level related to items scheduled for induction, items in process and items returned to the induction source. Interfaces with the history, financial systems provide job number opening and closing data and receives labor and material cost data generated by items in process. Output reports summarize production and cost data for management use.

j. NAVAIR Industrial Material Management System (NIMMS).
This system accumulates and reports management data used in the control of material inventory contained in Retail Stores and Direct Material Stores (DMI) located throughout the facility to support the productive effort. Statistical and analytical data available support the objective of adequate material support with minimum investment. Job material cost and financial inventory control are available through interfaces with the financial system and the NAS Supply System.

Figure 2.4: Financial Relationships

Source: NAVAIREWORKFACINST 4854.2D, March 22 1982

k. Work-In-Process Inventory Control System (WIPICS).
This system is designed to assist in the tracking and control of items processing through the rework facility. Work in Process (WIP) records generated by the OPDOCS system are automatically added to the WIPICS data base. The location and status is tracked from disassembly to reassembly by way of operator inputs via CRT terminals strategically located throughout the facility. Extensive interfacing exists between the WIPICS and Feedback system to ensure data accuracy. Status and location information is passed daily between the systems.

l. Automatic Storage, Kitting and Retrieval System.
This system provides support for management of receipt, auditing, storage, scheduling, progressing and shipment of workload for the Aircraft Division.

In addition, ADP program packages are available which provide data accumulation and reporting support for specific functional or program areas. Figure 2.5, reproduced from NAVAIREWORKFACINST 4854.2D Volume 4, depicts the relationships and interfaces between major ADP systems which support work and cost control objectives. [NAVAIREWORKFACINST 4854.2D]

D. OGDEN ALC

1. Activity Background

Ogden ALC is one of five government owned and operated activities providing depot level maintenance capabilities for the Air Force. Ogden Air Depot was activated on November 7, 1940 with establishment of the Depot Maintenance Department on February 11, 194 . On 1 July 1968, the Depot Maintenance Service, Air Force Industrial Fund (DMS, AFIF) was implemented at the five ALCs (designated as Air Material Area commands at this time) and the Aerospace Guidance and Metrology Center (AGMC), Newark AFS [Gorris, June 1984]. In July 1974, Ogden Air Material Area was redesignated as Ogden ALC. [Portrait in Partnership, 40 Years of Progress, 1980]

Figure 2.5: MIS for INAS

Source: NAVAIREWORKFACINST 4854.2D, March 22 1982

The Directorate of Maintenance at Ogden ALC has primary depot level maintenance responsibility for the F4/RF4 and F16 aircraft, and the Sidewinder, Maverick, SRAM, Titan II, and MX missiles. Under the Technology Repair Center (TRC) concept, the center specializes in the repair, overhaul, maintenance, analysis, and technical development of small missiles, armament, landing gear, wheels and brakes, trainer and simulator devices, photographic equipment, navagational accessories, electrical and mechanical instruments and pressure, temperature, and humidity measuring and control devices [Directorate of Maintenance Information Brochure, October 1983].

In accomplishing its assigned mission, the Directorate of Maintenance employs approximately 7100 civilian and 210 military employees. The function occupies 270 buildings with a replacement value of $282 million in a 7000 acre area and utilizes equipment initially costing $271 million. [FY 86 DMS, AFIF Budget Estimate, August 1984]

2. Organization

Given the integrated logistics support mission of the ALC, not all elements of the command structure depicted in Figure 2.6 are directly involved in the depot maintenance function. The Maintenance Directorate organization, depicted in Figure 2.7, is the primary execution agent for depot maintenance. The Maintenance Directorate is comprised of seven divisions; three production divisions organized by product and four supporting divisions organized by function. Other closely allied functional elements are the Directorate of Material Management, the primary direct "customer", and the Directorate of

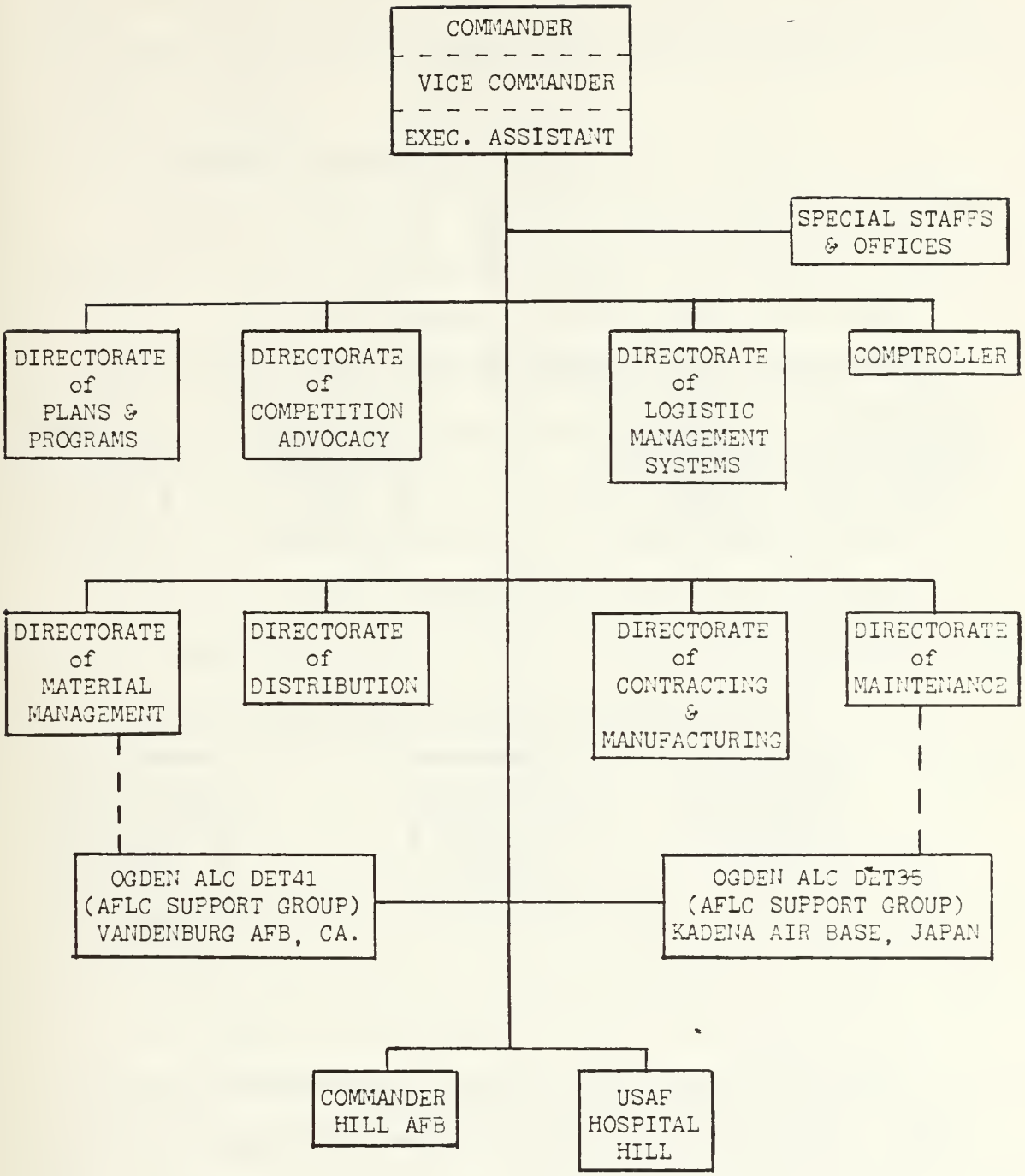

Figure 2.6: Ogden ALC Organizational Structure (Abbreviated)

Source: OO-ALC Organization, Manning and Directory Chart, 1 July 1984

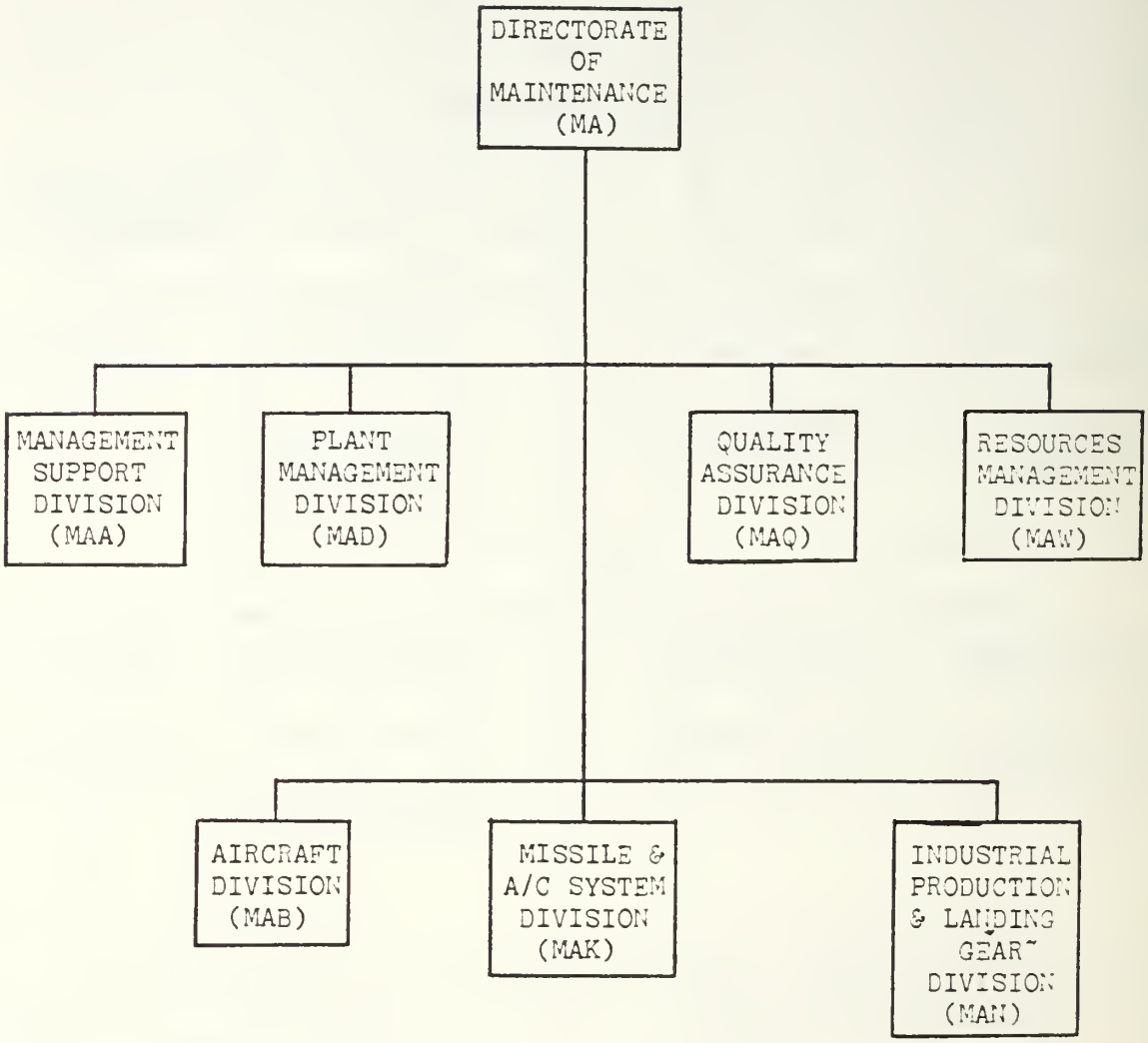

Figure 2.7: Ogden ALC, Maintenance Directorate Structure

Source: Ogden ALC, Maintenance Directorate Information Brochure

Distribution which provides material support. The organizational structure within the ALC and Directorate of Maintenance is relatively standardized across the five ALC's as is the high ratio of civilian to military personnel.

3. Management Systems

At the Directorate of Maintenance level, the operating budget forms a key tool in monitoring performance from a financial viewpoint. In addition, a set of 30 centrally controlled (AFLC) ADP based applications comprising the Depot Maintenance Data Systems Network provide a comprehensive, integrated means of accumulating performance and cost data by RCC and product. The system provides adequate flexibility to support financial and production management and monitoring at the various organizational levels as well as providing summary inputs to the AFLC and OASD level. The Depot Maintenance Data System, depicted graphically in Figure 2.8, consists of four requirements systems, three material systems, seven production systems, seven cost systems, and nine other systems. The overall system and individual component systems are described in "Depot Maintenance Automated Data Systems" promulgated by the AFLC Maintenance Directorate and summarized in the June 1984 thesis by Lieutenant Commander Gorris. At the AFLC level, the H036A system at each ALC provides cost and production data quarterly. The H036B system accumulates and reports annual cost and production data for forwarding by the AFLC to OASD. Other systems involved in process of cost accumulation, allocation, and reporting at the ALC level will be discussed further in the third section of this paper.

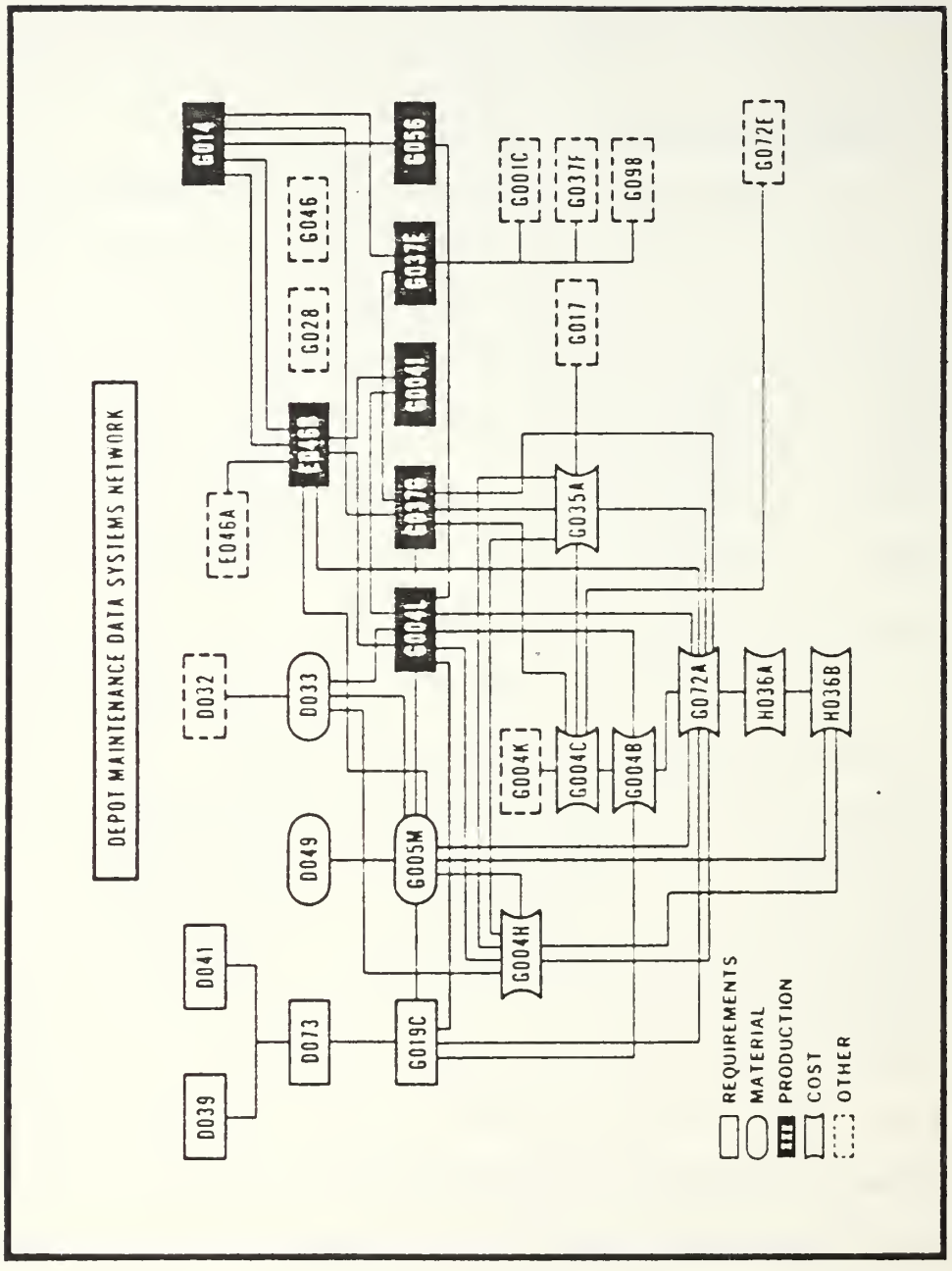

Figure 2.8: Depot Maintenance System Network

Source: Depot Maintenance Automated Data Systems
Warner Robins ALC, 1983

III. COST ACCUMULATION AND ALLOCATION

A. NARF NORTH ISLAND

The job order system in place at NARF North Island is an integral element in the activity's cost and NIF accounting system. Based on the general concept of association and accumulation of costs by end product (ex., an overhauled aircraft) and overhead activity (i.e., cost accounting, production control), the system provides a mechanism to systematically accumulate detailed labor, material, and other service costs by product or overhead activity. Except in the case of high volume, low unit cost components, which are batched in lots by customer, job orders are associated with specific end products (i.e., a cost object such as an aircraft or engine) or group of support activities (i.e., cost accounting) performed by a responsibility center. The flow of costs through the job order system is depicted in Figure 3.1.

As depicted in Figure 3.1, job orders are subdivided into the general categories of direct and indirect job orders. Direct job orders are those which identify costs to a specific end product such as a repaired or overhauled component or aircraft. Costs are accumulated by program (i.e., aircraft), subprogram (i.e., overhaul), TMS and performing cost center. In general, only direct cost centers (i.e., cost centers which perform the production function) may charge direct job orders. The primary exception occurs when an overhead cost center is performing in direct support of a customer requested and funded end

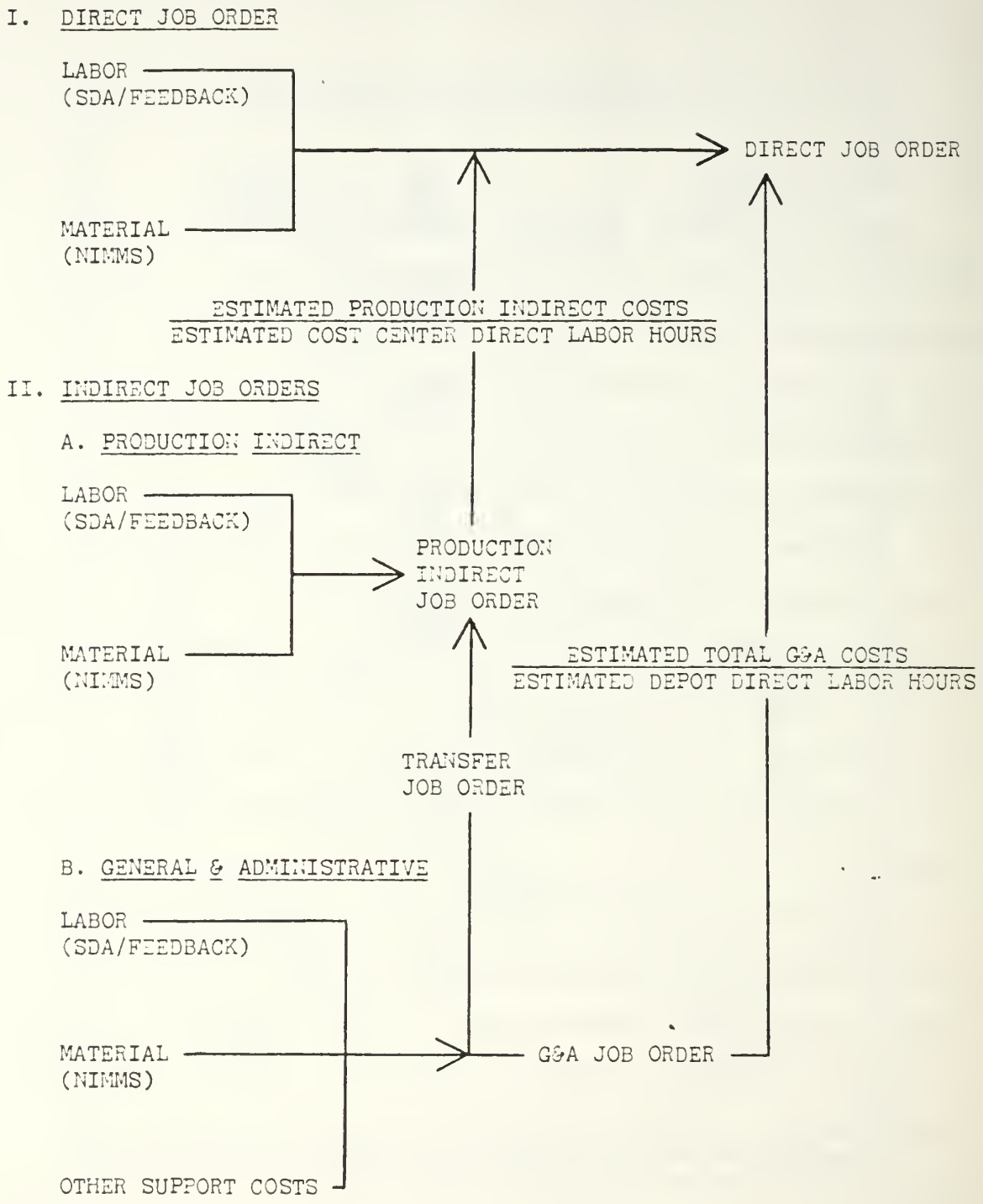

Figure 3.1: NARF NORTH ISLAND COST FLOW

Source: Adaption of NAVAIREWORKFACINST 7650.1D

product (ie. engineering design of modification components). The general structure for direct job orders is depicted in Figure 3.2.

Indirect job orders are established to accumulate overhead costs incurred in support of the production function which can not be assigned to a specific end product. Costs are accumulated by by type of activity and cost center. The majority of the indirect job orders are established annually as standing job orders to record the costs of overhead activities performed on a continuing basis. The general structure for indirect job orders is depicted in Figure 3.3. Functional cost classification codes utilized in the fourth and fifth position of indirect job order reflect NAVAIR assignments to provide for the standardization of accumulation and summarization of cost data by activity type generating the cost. The 214 functional codes contained in NAVAIREWORKFACINST 7650.1D, a sample of which are reproduced in Appendix C, provide for the comprehensive and detailed identification of indirect costs. Both direct and indirect costs are subdivided into labor, material, contractual services, and other costs. Costs funded from sources other than NIF, such as military labor, depreciation of MILCON funded facilities and materials funded by the Appropriation Procurement Account (APA) are captured by the system as statistical or unfunded costs. [NAVAIREWORKFACINST 7650.1D] Unfunded costs of general base support and appropriate allocations of NALC and NAVAIR management support costs are not captured by the system. The latter is included in UCA data by a percentage allocation performed at the rollover point for the activity group.[Jackson, October 1984]

Costs accumulated by indirect job orders are further subdivided into production indirect expense and general and administrative

Job Order Number

Customer Code

0 3 A 01 24

- Program; e.g. Aircraft
- Fiscal Quarter Inducted; e.g. 3rd Qtr
- Model Code (TMS); e.g. F4S
- Sub-program Code; e.g. Overhaul
- Serial Number; e.g. 24th aircraft of lot inducted
- Local Unique Component Code(Pgm 3 only)

Figure 3.2: DIRECT JOB ORDER STRUCTURE

Source: Adapted from NAVAIREWORKFACINST 7650.1D

Job Order Number

7 B 2 CC 00

- Standing Job Order Code; e.g. General Cost Center (6 = Prod. Indirect; 9 = Absence)
- Cost Center Code; e.g. Mgmt Cntrl Dept (Numeric for Production Division)
- Division Level; e.g. Comptroller Division (Branch Level for Production Indirect)
- Functional Cost Code; e.g. Budgeting (Refer to Appendix C)
- Assigned By Comptroller for specific purposes

Figure 3.3: INDIRECT JOB ORDER STRUCTURE

Source: Adapted from NAVAIREWORKFACINST 7650.1D

expense. Primary differentiation is based on the type of cost center generating the expense. Indirect costs incurred by Production (ie. direct) cost centers are by definition a production expense to be allocated to the end products worked by the cost center. Allocation is on the basis of cost center generated direct labor hours. In addition, cost transfers from non-direct cost centers for work directly identifiable to the production cost center (ie. Quality and Reliability Assurance, Production Control, and Plant Services) are a production indirect expense. This category of indirect expenses are identified by a "9" (Labor transfer) in the sixth position and an identifying digit for the benefiting productive division in the seventh position of the indirect job order number.

Labor and material costs incurred by general and administrative cost centers are by definition general and administrative costs. In addition, general and administrative costs include the reimburseable cost of external support services, and accruals for major maintenance expenditures. General expenses are allocated on a direct labor hour basis across the total productive effort of the activity. [NAVAIREWORKFACINST 7650.1D]

Job order openings originate from three sources. All production indirect and general expense job orders are manually opened by the Comptroller and closed at the end of each fiscal year. Job orders for engines and aircraft are opened automatically on a daily basis via a link with the OPDOCS system. On notification of completion, such jobs are manually placed in various closed status (i.e., closed to material, closed to labor, financially closed). Component job orders are

manually opened as required. A locally developed automated TMS Table aids in development of UCA required data elements for manual opening of component job orders. The first, fourth, and fifth elements of the job order define a work performance code from TMS Table 1. Utilizing this data and the first three digits of the job order, TMS Table 2 defines TMS, Nomenclature, WBSC, Standard Inventory Price, and equipment code (TMS or 1111 for aircraft). The TMS Table is updated at least annually. Current standard inventory price of major components is felt to be a significant problem by personnel responsible for keeping the TMS Table current.

Policy on handling components on concurrent rework on an aircraft is currently undergoing change. At the time of the site visit, concurrent component rework was separately funded and tracked by separate job orders. In FY 85, single funding of aircraft and concurrent component rework will result in return to a system in which component rework will be tracked by a psuedo job order number for work control and historical purposes. The psuedo job order will not be recognized by the financial system as costs will be accumulated under the aircraft job order. [Brinlee, August 1984]

DOD 7220.29H reporting requirements, as implemented by NAVCOMPINST 7390.1D and seven NAVAIR and NALC Uniform Cost Accounting (UCA) Bulletins, are accommodated by inclusion of UCA unique data elements in the work and job order initiation process. Collection of cost data is accomplished by the same systems supporting the NARF cost and NIF accounting functions. However, data for UCA reporting is maintained as a separate data base. This is necessary to accommodate the historical

cost nature of reporting on work completed during the period. All other systems accumulate data on an accrual basis for the current fiscal year. In all other aspects, the UCA file is a duplicate of the cost and NIF accounting files and receives the same update inputs. [Brinlee, August 1984]

Quarterly, an extract of UCA data elements for all jobs provisionally closed (i.e., closed to labor and material costs but available for adjustments) during the period is performed. The extract is used to create a tape in DOD 7220.29H format which is forwarded to NARF Jacksonville for consolidation with other NARF inputs. At year end, actual verses allocated cost variances are cleared by a computer routine. If the variance exceeds one percent, the program reallocates the cost variance to all jobs worked during the year. Variances of less than one percent are closed to retained earnings. After reallocation of variances, the job order status is changed from provisionally closed to financially closed. The year end UCA report tape is based on an extraction of data from job orders designated as financially closed. Prior to forwarding of any tape, cost data on the tape is personally reviewed and validated against data in the financial files by the UCA coordinator, Mr. Brinlee. Exact dollar match is the validation criteria. However, any account with a credit balance is deleted from the UCA data which causes a minor but identifiable overstatement variance compared with financial file data.[Brinlee, August 1984]

1. Labor

All labor hours are input via SDA system transactor terminals located in each cost center. For direct hours, the employee records

commencement of work on a specific item by input of an employee card and a link card and line number contained in the work package generated by the OPDOCS system. The link card provides a link to the direct job order. The system currently operates on the assumption that all hours since the last transactor entry, minus normal breaks and non-duty hours, are assignable to the previously logged operation. Overhead inputs, such as training and leave, or changes to normal duty hours in production work centers are accomplished by way of a supervisory override input capability. The system validates both the employee identification and the job order number against master files. For indirect cost center personnel and production cost center supervisory and administrative personnel, the system assumes assigned personnel are performing the assigned overhead activities during normal hours. As in direct centers, exceptions to normal duty function or hours of performance are entered by supervisory personnel on ADP terminals. To minimize the potential inaccuracies of system assumptions, cost center supervisors receive daily labor exception reports for the previous day. Included in the exception report are all non-direct hours for production cost centers. All hours against other than the general cost centers normal functional code, hours outside normal duty and/or shift periods and non-matches between hours logged via SDA and the time keeping system are also reported. All exceptions continue to be reported until cleared by the responsible supervisor. Any unresolved exceptions existing when the quarterly UCA report is developed are noted in a UCA exception report and must be resolved prior to report finalization. Integration of the time keeping system, which is

currently in progress, will remove the assumption as to work day stop and start time. [Henry, August 1984]

Using hour inputs via the SDA system combined with personnel and system data held in master files (i.e., current employee pay rates, the current NARF wide acceleration factor for employee benefits, shift, overtime and holiday premium factors, assigned work center, and normal duty and break periods), the system performs daily updates of hours and labor cost by job order, function, and cost center.

The NARF acceleration factor used to develop labor costs is developed independently by budget personnel at each NARF on an annual basis. This factor, currently 28 percent at NARF North Island, is based on total anticipated benefit costs (holidays, leave, pension, and health insurance) and total hours available for the planned manning level. Variances between actual and accrued benefit costs, with the exception of leave and compensatory time, are closed at year end to retained earnings. [Jackson, August 1984]

The work package forwarded to the production work center from the OPDOCS system is developed based on standard hours to perform a specific work element (i.e., line number). With the standard hour input from OPDOCS, the Feedback system is able to generate labor hour variances by job order, line number, and cost center. Responsibility for explanation of hour variances is placed at the cost center level. Handling of variances will vary with job order reimbursement agreement (fixed priced or stabilized rate reimburseable) and assessment of variance cause. The spectrum of possible dispositions of variances ranges from assignment to cost center overhead to inclusion in the job order.

The NIF system operates on the principle of recovery of direct labor cost by means of a standard or stabilized labor rate for a skill area (i.e., welder) based on anticipated labor skill mix, wage rates, and work load. Consequently, labor price variances are also tracked for NIF purposes. While variances caused by stabilized rates are cleared to retained earnings at year end as a gain or loss, UCA and cost files reflect actual hours at current wage rates.

2. Material

In performing it's maintenance mission, NARF North Island depends on the following sources of material: the supply system (53 percent); local manufacture (33 percent); and commercial sources (14 percent). The NIMMS and Financial ADP systems track all order, receipt, issue and related financial transactions and provides transaction and status monitoring capabilities by way of numerous exception and summary reports. The NARF material system operates on the costing principle of applying the current inventory carrying price, on issue, to appropriate direct and indirect job orders. [Smith, August 1984] All material costs, both direct and indirect, are cleared through one of the following four inventory accounts:

a. NIF Inventory (NIFI)
Material in this account, which represents some 30 to 40 percent of the total inventory, is funded from the NIF corpus to support ongoing rework programs based on usage factors. The inventory price for all standard stock items (ie NSN materials) in inventory is updated daily based on Fleet Material Support Office (FMSO) Navy Management Data List (NMDL) updates received by the local Navy Regional Data Center (NARDAC). Non-standard stock items manufactured for NIF inventory are carried at an average price based on total item inventory and cost of manufacture, including indirect allocations. Non-standard commercial source stock is carried at receipt invoice price, including transportation if noted on the invoice. Transportation costs not

available on material receipt are accumulated in general overhead.

b. Customer Furnished Inventory (CFI)
Material in this account, which represents approximately 5 percent of total inventory, is provided by the customer for use on a specific job. Issues from this account are reflected as a statistical charge against the customer job order.

c. Direct Material Inventory (DMI)
This account, representing approximately 7 to 8 percent of the total, provides control over customer funded materials procured to support work planned for induction on complete availability of material. As such, the purchase cost of such material is essentially a liability to the NIF system. With issue, the liability is reduced and a balancing expense recognized against the customers job order. Individual line items are carried in inventory at either standard cost or receipt cost depending o source.

d. Specific Requirement Inventory (SRI)
Material in this account, representing 45 to 50 percent of the total, is procured or manufactured to support a requirement for a unit currently in progress. On receipt, material is issued to the job order at receipt cost of the line item. [Jackson, August 1984]

Exchange materials form a sub-category which receive slightly different handling. For exchanges, the total cost is statistical as such materials are owned by the item manager who is responsible for the purchase and repair of such items using Appropriation Procurement Account (APA) funds. Replacement APA items are statistically billed to the customer job order via either the SRI or DMI account at either the full standard stock price or, with a repairable carcass in exchange, at 20 percent of the standard stock price. Repair of such repairable carcasses is performed on a separate job order against item manager provided funds with the local supply center acting as the item managers agent. [Smith, August 1984]

Price variances due to either changes in standard stock prices or acquisition of standard stock items from non-supply system sources

at a price different than the standard are cleared to overhead as a gain or loss to inventory. Otherwise, material is costed to the appropriate direct or indirect job order at receipt price. Material usage variances for a direct job order is tracked within the material division. Explanation of the variance rests with the production work center supervisors. Disposition options for the variance range from reassignment to work center overhead to retention in the customer job order, depending on the circumstances. [Smith, August 1984]

3. Production Indirect

Production indirect costs include the cost of all support directly associated with a specific production work center. The majority of such costs are accumulated by labor and material systems already discussed. Costs from contract or other sources are handled in a similar manner of accumulating costs against a specific work center indirect job order. When a direct link to the cost center does not exist or the costs apply across a number of cost centers and cannot be segregated in a cost effective manner, the costs are accumulated in general overhead. Major sources of indirect costs would include:

a. Shop supervision and assigned administrative support is accumulated as performed against a specific work center indirect labor job order.

b. Bulk and Pre-expended bin material utilized by productive shops are costed to a specific work center indirect material job order at the time of issue or replenishment from NIFI.

c. Transferred costs of non-direct work centers specifically identifiable to a productive work center such as Production Quality Assurance performed in the work center. Costs are accumulated as incurred against a transfer job order and subsequently treated as an indirect cost of the supported production cost center.

d. Depreciation expense for plant equipment or improvements specific to a particular production cost center is accumulated as an indirect cost of the production cost center. Primary guidance for funded depreciation by NIF activities is provided by NAVCOMPT 7600.27. Funded depreciation within the NIF system provides a means to accrue funds required for replacement of capital assets. All capital equipment or plant improvements procured with NIF funds with an acquisition price greater than $1000 and a service life greater than 2 years are individually capitalized and depreciated on a straight line basis over the estimated service life. A deduction of salvage value from acquisition price in determination of a depreciation rate is allowed by the guidance. However, NARF North Island policy, which appears uniform across the activity group, is to assume a zero salvage value. NAVCOMPT guidance requires periodic reevaluation of the service life assumption with adjustment of the depreciation rate as necessary to preclude in-service items from being fully depreciated. Plant equipment acquired prior to commencement of funded depreciation in October 1983 which meet threshold criteria, regardless of funding source, are included. Any such items still in service but carried as fully depreciated were subject to a one time adjustment to market value with depreciation over the estimated remaining useful life.

Recovery of production indirect costs is based on application of a productive indirect rate to each direct hour worked by the cost center. The rate is developed during operating budget formulation and is based on anticipated workload and associated total indirect costs for the work center (ie Total estimated indirect costs for the cost center/Total estimated direct labor hours by the cost center). For cost accounting purposes, the rate is adjusted at least quarterly to minimized price and volume variances between actual and allocated costs. At year end variances greater than one percent are subject to reallocation to direct job orders worked during the year.

4. General and Administrative Overhead

All costs not directly associated with an end product or clearly associated with the functioning of a direct work center are, by default, general costs. This category includes the costs incurred in

the administration, management and general operation of the maintenance activity. Major subcategories include the costs incurred by designated General and Administrative (G&A) cost centers for performance of specific overhead functions and general operational costs of the depot for which the most cost effective means of accumulation is as a general overhead cost.

G&A cost enter job orders accumulate costs by cost center and type of activity performed in a manner similar to indirect costs for direct cost centers. General operational costs such as utilities, and transportation are accumulated by expense type using job orders established annually by the comptroller. Major categories of general operational cost include:

a. Depreciation expense.
Depreciation expense for facilities and equipment not specifically identifiable to a production cost center are accumulated as a general and administrative expense. Depreciation expenses for facilities and associated equipment acquired with MILCON funds are accumulated as an unfunded general and administrative expense. The scope of items subject to capitalization by NARFs appears to be an area still under review. NARF North Island has recently included Materials Handling Equipment (MHE) and is currently considering inclusion of other transportation assets [Ferrick, August 1984]. With this change, vehicle replacement accurals formerly captured through rental fees paid to the Public Works Center as a base support cost will be reflected as a depreciation expense. Operational costs such as fuel and maintenance will continue to be reflected in base support reimbursable costs. Unlike commercial counter-parts where the practice is contrary to Generally Accepted Accounting Practice (GAAP), the guidance also provides for capitalizing the cost of software development/acquisition and implementation exceeding $100,000 with a 2 year service life. At the time of the site visit, the NARF had no capitalized software.

b. Reimbursable Base Support Functions
The cost of services provided on a reimburseable basis by other NAS North Island commands in support of NARF North Island are accumulated by overhead job orders, by service type as incurred, based on monthly billings. NAVAIREWORKFACINST 7650.1D classifies

such costs as either direct or allocated reimbursable support. Direct support costs are those specifically identifiable to support of the NARF. Included in this area are all public works support, NARF guard services, and ADP equipment rental and supplies. Allocated support costs are those which, at the time of performance, cannot be specifically identified to the NARF and must be allocated in accordance with OPNAVINST 7600.1. Functions subject to allocation are listed in Appendix D which is extracted from NAVAIREWORKFACINST 7650.1D. Proportionate shares of other general base support function costs not included in the list of allocated reimburseable support, such as supply support and military personnel support, are not accumulated.

G&A costs are applied to each direct hour worked based on a G&A rate developed as part of the operating budget. The rate is developed based on total anticipated depot G&A costs divided by total anticipated direct labor hours for the depot. To preclude significant over or under allocation (greater than 1 percent), the rate is reviewed and revised at least quarterly. At year end, variances greater than 1 percent are reallocated to all direct job orders worked during the year.

B. OGDEN ALC

Ogden ALC accumulates direct or production costs based on an actual rate, actual hour process cost system. Key to this system, as well as the accumulation of production indirect and general and administrative costs, is the concept of accumulating costs by responsibility cost center (RCC) and, for labor hours, duty code (DC)(i.e., normal duty, leave, training). RCCs may be designated as direct (i.e. production) or indirect (i.e. plant maintenance, cost accounting), which includes both direct production support and G&A type RCCs. Duty codes for labor permit segregation of direct and non-direct hours within the RCC. Overlaying the process cost system is a product job order system

against which accumulated costs are allocated based on standard hours. The end result is a system which provides average costs for the production of end items.

The flow of costs within the Depot Maintenance Automated Data System is depicted in Figure 3.4. Service or support center costs incurred in direct support of production RCCs are transferred by an "Admin Table" contained in the G035A, Depot Maintenance Budget and Management Cost System. The service center RCC is linked to supported production RCCs and the costs of the service center are allocated based on the ratio of a supported RCC's actual direct hours to the total actual direct hours of all supported RCCs. The accumulated costs of G&A cost centers, including psuedo G&A RCCs established to accumulate Base support and other miscellaneous G&A costs, are allocated to production RCCs based on the ratio of the RCCs actual direct hours to total direct hours generated. Total production RCC costs are then allocated to product job orders by the G072A, Depot Maintenance Production Cost System. Allocation of production RCC costs to the job order is on the basis of the ratio of product standard hours (i.e., product standard hours multiplied by equivalent units of the unit produced) to total standard hours for the equivalent unit count of all products produced by the RCC. [Pitt/Haywood, October 1984]

As the Depot Maintenance Automated Data System, which is central to the process, is centrally controlled by AFLC, the general process described is equally applicable at any ALC [Col. Dix, October 1984]. Primary differences, rather than systematic, would be operationally and regionally oriented such as product lines, local labor rates, scale of operation and such related characteristics.

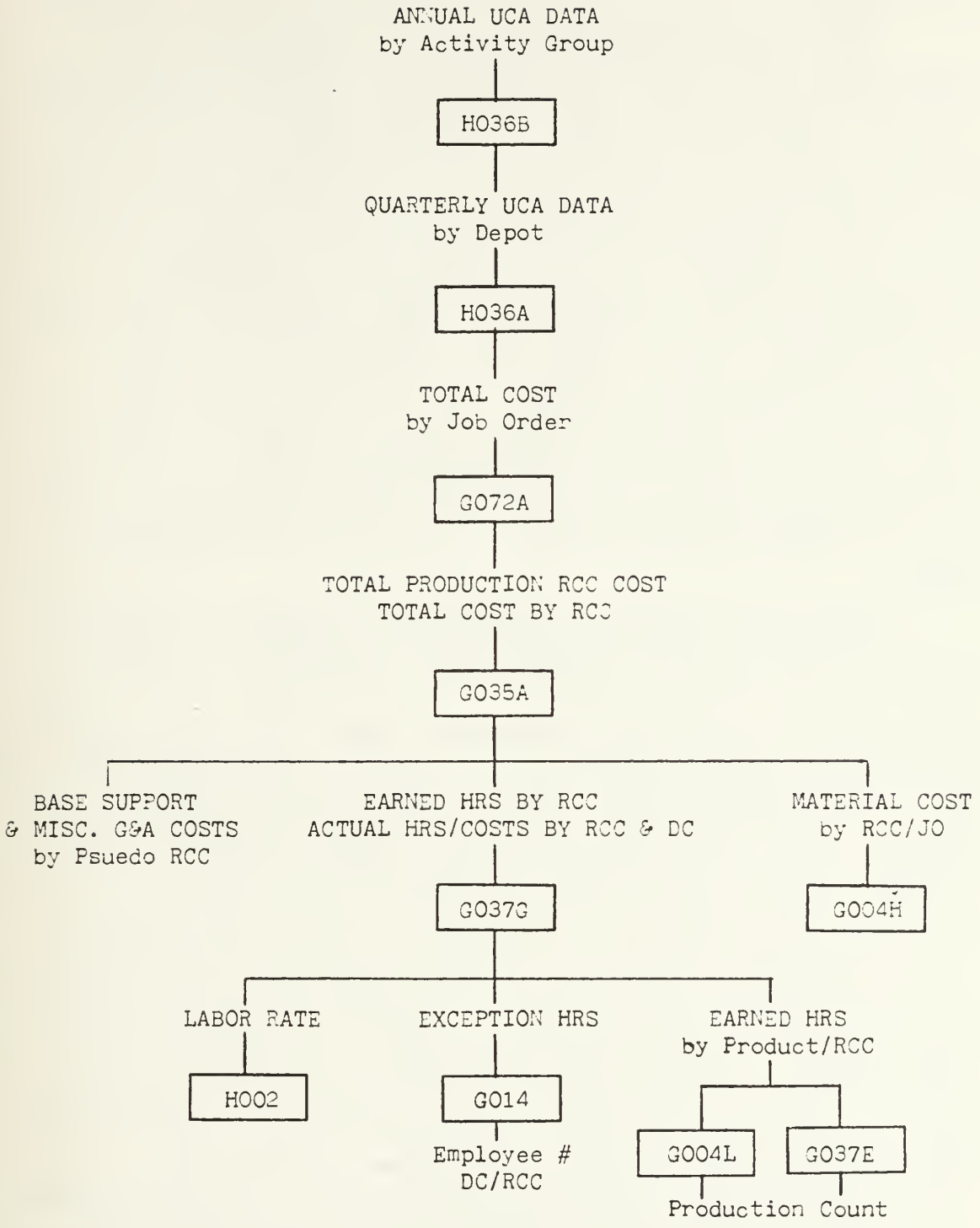

Figure 3.4: Air Force Depot Maintenance Cost Flow

Source: Depot Maintenance Automated Data Systems
Warner Robins ALC, 1983

1. Labor

Labor hours and production count (i.e. equivalent units produced) data are entered via remote terminals located throughout the facility. The system only requires input of exception duty codes (i.e., other than normal duty such as leave or training) and RCC for labor input. Otherwise, personnel are assumed to be engaged in performance of normally assigned duties within the assigned RCC. Data is accumulated by the G014, Remote Data Collection System, which subsequently provides labor exception inputs to the G037G, Labor Distribution and Cost System, and production count data to the G004L, Job Order Production Master System, and G037E, Work Load Planning System.

Production count data is processed in conjunction with labor standards files to produce Standard Direct Product Hours (SDPH) or earned hours by product and RCC which are input to the G037G. The labor standards used are based both on engineered studies and historical data. Key factors in any work element standard are the component repair occurrence factor (ie failure rate based on expected/experienced mean time to failure), component count for the unit, and component replacement factor which adjust the engineered repair standard. The net result is allowance of a statistical mean number of hours for the performance of a given repair action based on a normal work pace and experience level. [Creed, October 1984]

Using exception hours from the G014 and actual labor rates input from the H002 (civilian) and H069 (military) systems, the G037G computes Direct Product Actual Hours (DPAH) and actual labor costs by

DC and RCC. The labor costs are accelerated to recover fringe benefit costs. The acceleration factor, currently 35 percent, is analyzed and adjusted monthly to minimize variance between incurred and accrued costs [Creed, October 1984]. Hours and labor costs accumulated against a direct DC in a production RCC are allocated to products processed by the RCC by the G072A, Production Cost System. The allocation is based on the ratio of standard hours for a product to total direct standard hours generated by the RCC. Hours and labor costs accumulated against an indirect DC within a production RCC are similarly allocated. Labor costs for production support RCCs and G&A cost centers are allocated to the production RCC based on actual direct hours by the G035A system. Subsequently, the costs are allocated to product job orders worked by the production RCC based on standard hours. [Pitt/Haywood, October 1984]

2. Material

Material stocking levels within the Air Force maintenance system are based on projected item workload and statistical usage factors developed from historical data. Like the Navy, sources of material include the supply system, commercial sources and local manufacture. However, local manufacture plays a less significant role and is primarily a source of jigs and other such special production support items [Creed, October 1984]. Material issues consist of three basic categories: regular Maintenance Inventory Center (MIC) stock which consists of a number of stock points segregated by and co-located with major system production facilities; bench stock which is similar to NARF pre-expended bin material, and floating stock which consists of

automatic test equipment, flight test items and servicable assemblies to support production lines.

All material issues are made by way of MIC inventory accounts. Issues are costed at current inventory carrying prices. For NSN stock, the carrying price is the current system standard price. The majority of stock price changes are received at the beginning of each fiscal year. However, monthly price changes are received throughout the year on a limited number of line items ($50k in price changes per month on $20 million MIC inventory). Price and usage variances are not segregated and are treated as an offset to G&A material costs. Commercial items are procured via the supply system and are priced at purchase price plus a seven percent material surcharge. [Creed, October 1984]

All material issues are requested on an AFLC Form 244. Receipt of a processed 244 advises the D033, Depot Supply Stock Control and Distribution System, of the issue. The D033 in turn passes the quantity and cost by stock number and control number to the G004H, Material Cost System, on a daily basis. Cost data is subsequently passed to the G035A by RCC and, for material issued to direct work, job order number. Material issued to indirect and G&A RCCs are accumulated and allocated in the same manner as indirect and G&A labor. [Depot Maintenance Automated Data Systems, 1983]

3. Production Indirect

The production indirect costs generated within a direct RCC are identified and accumulated by RCC and non-direct DC by the labor and material systems already discussed. In addition, the "Admin Table"

contained in the GO35A provides the ability to transfer the cost of production support RCCs to a supported direct RCC based on actual direct labor hours. To accommodate the situation in which a functional group is involved both in production support and G&A type functions, multiple RCCs can be assigned to accumulate costs for each sub-area. Rework costs are also accumulated as production overhead.

4. General and Administrative Overhead

Costs of G&A work centers are accumulated by RCC and DC by labor and material systems previously discussed. Other G&A type costs such as Base Support are accumulated against psuedo G&A RCCs. Direct Base support is funded by AFIF and captured as funded overhead. In addition, the remaining costs of various base operations from which the Maintenance Directorate derives some benefit, despite the lack of a direct relationship, are accumulated as unfunded costs. AFLCR 170-10 provides detailed and comprehensive support identification and allocation basis guidance for such unfunded base support costs. Unfunded base support costs for the Ogden ALC, Maintenance Directorate are estimated at $1.2 million per month or $14.4 million per year as compared to approximately $5 million in funded base support costs.

Like the Navy, funded depreciation expense is included in overhead costs to accrue funds required for replacement of capital equipment. All assets or plant improvements funded with AFIF funds with an acquisition price greater than $1k and a service life greater than 2 years is capitalized and depreciated. Depreciation is on a straight line basis. The depreciable base is 95 percent of acquisition price based on a standard 5 percent salvage value assumption. Service

life for plant equipment and software is set by standard at 12 years which averages out to 132 months with recognition of depreciation expense only in full fiscal years of use. Use of a different service life requires justification such as historical experience, technical obsolescence, etc. Service life assumptions are reviewed periodically and the depreciation rate adjusted to preclude full depreciation of assets still in use. Unfunded depreciation for plant assets acquired by other fund sources (ie facilities procured with Military Construction funds) are also captured as a statistical overhead cost by the system.

C. SUMMARY

While starting from markedly different management decisions systems as to type of cost system, the scope and handling of overhead costs are similar. Both systems display extensive automation with a comprehensive system of checks to maintain the validity of the data base. The apparent magnitude of difference is accentuated by differing policies as to classification and accumulation of funded/unfunded overhead costs and differing capabilities of the particular cost system implementation to accumulate and allocate production support costs in a cost effective manner. However, comparison of total overhead costs, without consideration of funded/unfunded or production indirect/G&A classifications, reveals only the following differences:

- ALC accumulation of material support costs as part of unfunded general base support costs. In 1984 these costs amounted to $10.9 million of the total overhead costs of $175.3 million.

- ALC accumulation of Military personnel administration costs. In 1984, the costs allocated to Ogden ALC amounted to $65.7 thousand.

- The two activities apply differing assumptions as to salvage value of acquired capital equipment. The ALC uses a standard of five percent of acquisition price. The NARF assumes a zero salvage value. The differing assumption effects the depreciation rate and, consequently the annual depreciation expense recognized.

With regard to allocations, the methods used by the two activities are, on close inspection, merely two formulations of the same allocation scheme. Both systems allocate on the basis of direct labor hours. The NARF uses a rate per direct labor applied based on direct labor hours worked. To minimize allocation variances, the rate is periodically adjusted with application of significant year end variances to all units worked during the year on the basis of direct labor hours. The ALC utilizes the ratio of direct hours for a product or activity to total direct hours to apply actual costs accumulated.

The following chapters will explore the impact of both the degree of similarity and differences identified on comparability of overhead costs bettween activities and activity groups.

IV. COMPARISON OF COST SYSTEMS

A. COMPARABILITY OF PRODUCTION INDIRECT AND G&A COSTS BETWEEN SERVICES

Review of the information contained in Chapter 3 on the handling of overhead costs by the two activities investigated leads to the conclusion that comparison of production indirect costs or the comparison of G&A overhead costs between military services is not feasible. The primary cause is the capability of the ALC system to allocate production support costs as required by DOD 7220.29H. The G072A "Admin Table" provides extensive and flexible allocation capabilities compared to the limited capability of the transfer job orders used by the NARF system. Consequently, cost allocated to production indirect costs by the ALC system are absorbed in G&A overhead costs in the NARF system.

Data in Table 6 of DOD report RCS DD-M(A) 1397 supports the conclusion of a systematic difference in handling of overhead costs. When the percentage of total activity overhead costs reported as production indirect costs by the NARFs and ALCs are compared, the data are consistent within an activity group (NARF; mean of 41.20 percent with a standard deviation 3.83: ALC; mean of 61.81 percent and standard deviation of 2.81). The difference between the two sample means is statistically significant ($p<0.001$). While the percentages noted above are derived from FY83 data, a similar result was obtained with data from prior years as demonstrated in Table IV - I. The t-statistic cited in Table IV - I was derived using the

Smith-Satterwaite test [Miller & Freund, p.174] because the test of variances did not support the hypothesis that the variances of the two samples were the same ($p<0.05$)for the data sets from 1979, and 1981 (i.e., the computed F statistic cited in Table IV - I is greater than the critical value, F(.975,5,5,) of 7.15).

Table IV - I

PRODUCTION INDIRECT AS A PERCENTAGE OF TOTAL OVERHEAD COSTS

FY	NARF		ALC		F-statistic for Variances	t-statistic for Means
	Mean	Std deviation	Mean	Std. Deviation		
1979	43.13	2.43	62.33	6.48	7.480	6.058 *
1980	40.41	7.34	66.03	3.66	4.103 **	7.002 *
1981	40.71	6.91	62.51	1.90	12.774	6.927 *
1982	42.86	3.70	63.66	2.65	2.025 **	10.091 *
1983	41.20	3.83	61.81	2.81	1.854 **	9.692 *

* $p<0.001$

** $p<0.05$

While the difference in handling of overhead costs precludes comparison of production indirect or G&A costs among military services, modeling of the two systems indicates the different handling of overhead costs is neutral with regard to impact on total overhead allocations to an end product. Using historically based ratios for direct labor to overhead labor and direct costs to overhead costs for both activity groups (51/49 and 60/40 respectively) [Hawkins, October 1984; Creed, October 1984] and assuming a cost center operating with an

average 95 percent efficiency (ratio of actual hours to standard hours) for multiple products representing 10 percent of the total productive effort, end product total cost did not change with changes in relative proportions of production indirect and G&A overhead as long as direct labor hours were not changed.

B. COMPARISON OF TOTAL OVERHEAD COSTS BETWEEN SERVICES.

1. Comparison of Scope of Costs Included in Overhead

Differences in the relative proportions of overhead costs identified as production indirect or G&A preclude comparison of overhead cost at that level of detail. Differing classification of overhead costs as funded and unfunded by the NARFs and ALCs add to appearance of non-comparability of overhead costs. In the area of general base support costs, AFLC 170-10 lists more than thirty categories of activity costs to be included in unfunded base support. The NARFs do not accumulate unfunded base support costs. However, the majority of the unfunded base support costs accumulated by the ALCs are included in the allocated reimburseable (i.e., funded) support costs accumulated by the NARF. Given the differences in identification of overhead costs as production indirect or G&A and funded or unfunded, comparison on a macro-basis (i.e.,total overhead cost) would be a possible alternative. Investigation of this alternative, through review of the cost accumulation systems and review of NAVAIREWORKINST 7650.1D and AFLCR 170-10, confirmed the viability of this alternative as a basis for comparison. Once overhead costs are considered in total, without arbitrary sub-divisions, the categories of overhead

costs accumulated are nearly identical. Only the following three areas of difference were noted in comparing the categories of overhead costs accumulated by the two cost systems:

a. Depreciation Expense.
The Air Force system reduces acquisition price by 5 percent to account for salvage value. The NARFs assume a salvage value of zero. The difference is a matter of judgement as to potential salvage value. Both positions are supportable within the guidance of DOD 7220.29H:

> Using recorded fixed asset acquisition costs including transportation and installation, less estimated residual value significantly in excess of scrap costs.

The result is that NARF annual depreciation expense would exceed that of an ALC by 5 percent for similiar plant assets. Total FY 84 depreciation expense for NARF North Island was $8.7million [Jackson, December 1984]. If reported under the ALC method, total depreciation expense would be $8.26 million, a difference of $435 thousand. However, when compared to total FY84 overhead costs of $162.2 million [Jackson, December 1984], the variance introduced is only 0.27 percent and is not material.

b. Unfunded Military Administration Support.
The ALC system accumulates, as unfunded general base support costs, a percentage of the operating cost of the base military personnel administration function. The allocation is based on the percentage of assigned military personnel with respect to total base military population. The NARF system does not accumulate unfunded base support costs and, in this instance, the cost is not part of allocated reimbursable support. However, military personnel assigned to the depots comprise a small percentage of the base military population (145 of 5643 or 2.7 percent for Ogden ALC)[Directorate of Maintenance, Ogden ALC, Information Brochure, October 1983]. In FY84, unfunded military personnel administration costs for Ogden ALC were $65,730. When compared to total overhead costs of $175.3 million, military personnel support is only 0.04 percent of the the total [Heiner, December 1984]. Given the small percentage of total overhead costs accounted for by military administration costs, failure to include military administration costs will not impact comparison of overhead costs reported by the two Services.

c. Unfunded Supply Operations Costs.
The Air Force system accumulates unfunded supply support costs as part of unfunded base support. The allocation is based on line items/issues to the activity as a percent of base total [AFLCR 170-10, 29 June 1979]. As previously noted, the NARF does not

accumulate base support costs unless funded, which supply support costs are not. For Ogden ALC, FY84 supply support costs of $10,959,222 comprised 75.8 percent of the total unfunded base support costs [Heiner, December 1984]. However, total unfunded base support costs of $14.462 million are only 8.25 percent of total overhead costs of $175.341 million in FY84. Therefore, the omission of supply support costs would have reduced total reported overhead costs by 6.25 percent.

As depreciation difference has the reverse effect of the other two areas, the three areas of difference, in total, would affect the overhead costs reported by 6.02 percent. This difference is considered minor enough to permit comparisons of overhead costs reported by the ALCs and NARFs without including adjustments for the cost differences in the analysis.

2. Relationship Between Overhead Costs and Direct Labor Hours

As the activities reporting depot maintenance costs vary significantly in size of operation (6,000 to 15,231,000 direct labor hours based on RCS DD-M(A) 1397 Table 6 data for FY83), a factor to permit comparison of costs between activities conducting operations of differing scales is needed. In an effort to identify such a factor, total overhead cost and direct labor data from Table 6 of the 1397 report for FY83 for the Air Force depots and NARFs was arrayed in order of increasing direct labor hours. As depicted in Figure 4.1, the result displays a strong positive linear relationship (r-squared of .962 and F statistic of 256.041 significant at the .001 level).

A similar regression using data from all the military services (Ship Repair Facilities were excluded due to the possible impact of lower costs in overseas areas) displays the strong linear relationship (r-squared of .937 and the F statistic significant at the .001 level)

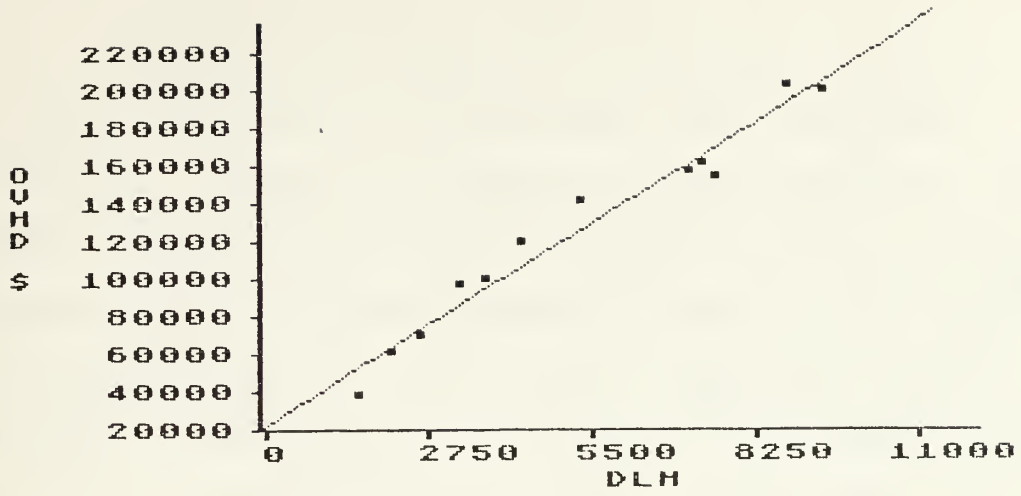

Figure 4.1: Overhead Costs (000) verses Direct Labor Hours (000) NARFs and ALCs - FY83

depicted in Figure 4.2. Regression of data from FY79 through FY82 displayed similar results as depicted by graphs in Appendix E. The results are summmarized in Table IV - II. While, the relationship appears highly linear, the existence of data clusters by activity groups raised questions as to the validity of treating the data on a pooled basis.

Table IV - II

Summary of Linear Regression Results

FY	Constant	Slope	r-squared	F-value	SEE
1979	2836.262	13.973	.883	240.439	13707.808
1980	6463.446	13.134	.963	850.191	10100.477
1981	417.600	17.031	.964	888.730	12137.112
1982	10682.891	15.593	.952	656.462	20392.205
1983	5487.473	18.569	.937	493.477	19672.805

(SEE; Standard Error of Estimate)

* p<.001

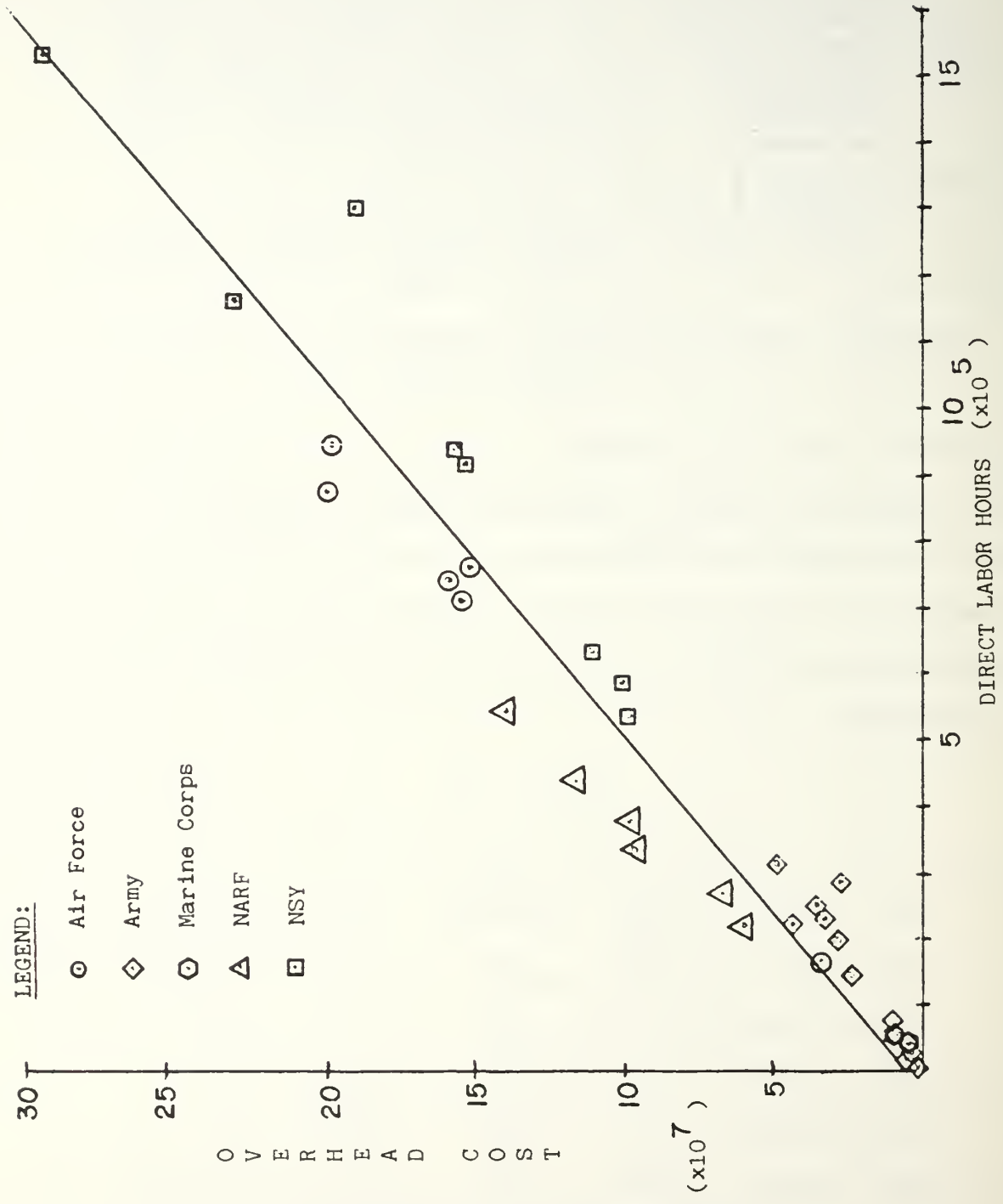

Figure 4.2: Overhead Cost vs Direct Labor Hours
FY83 - All Except SRFs

An analysis of the residual plot depicted in Figure 4.3 reveals no discernible pattern which would suggest that a linear model is inappropriate. However, the clustering of activity group data points is again evident in that activity group residuals tend to be either positive or negative. This finding led to further testing of the model to determine if the data could be treated as a single line [Neter and Wasserman, pp. 160 - 165]. At a .05 level of significance, the test for identical regression lines failed (i.e., computed test statistic of 6.4867 which exceeds $F(.95,3,14) = 3.34$), indicating that the data was not a single line (i.e., the hypothesis that the slope and intercept coefficient of each activity group's regression line were the same was not supported). The Army data did not display a statistically significant linear relationship (r-squared of .374) and a valid regression could not be performed on the two Marine Corps depots. Therefore, these activity groups were excluded from the analysis. Further tests of the slope coefficients for the NARF, ALC, and Naval Shipyard (NSY) activity groups' regression coefficients did support the hypothesis that the slope coefficients were the same ($p<0.05$) [Neter and Wasserman, pp. 166 - 167]. Data from the test of slope coefficients is summarized in Appendix F. The test results imply that the relationship between overhead cost and direct labor is described by a family of lines, by activity group, with a common slope and different vertical displacements.

Based on findings of prior research [Burnett, 1984: Gorris, 1984; Tackett, 1984] it was anticipated that regional price differentials might induce some difference in reported overhead costs.

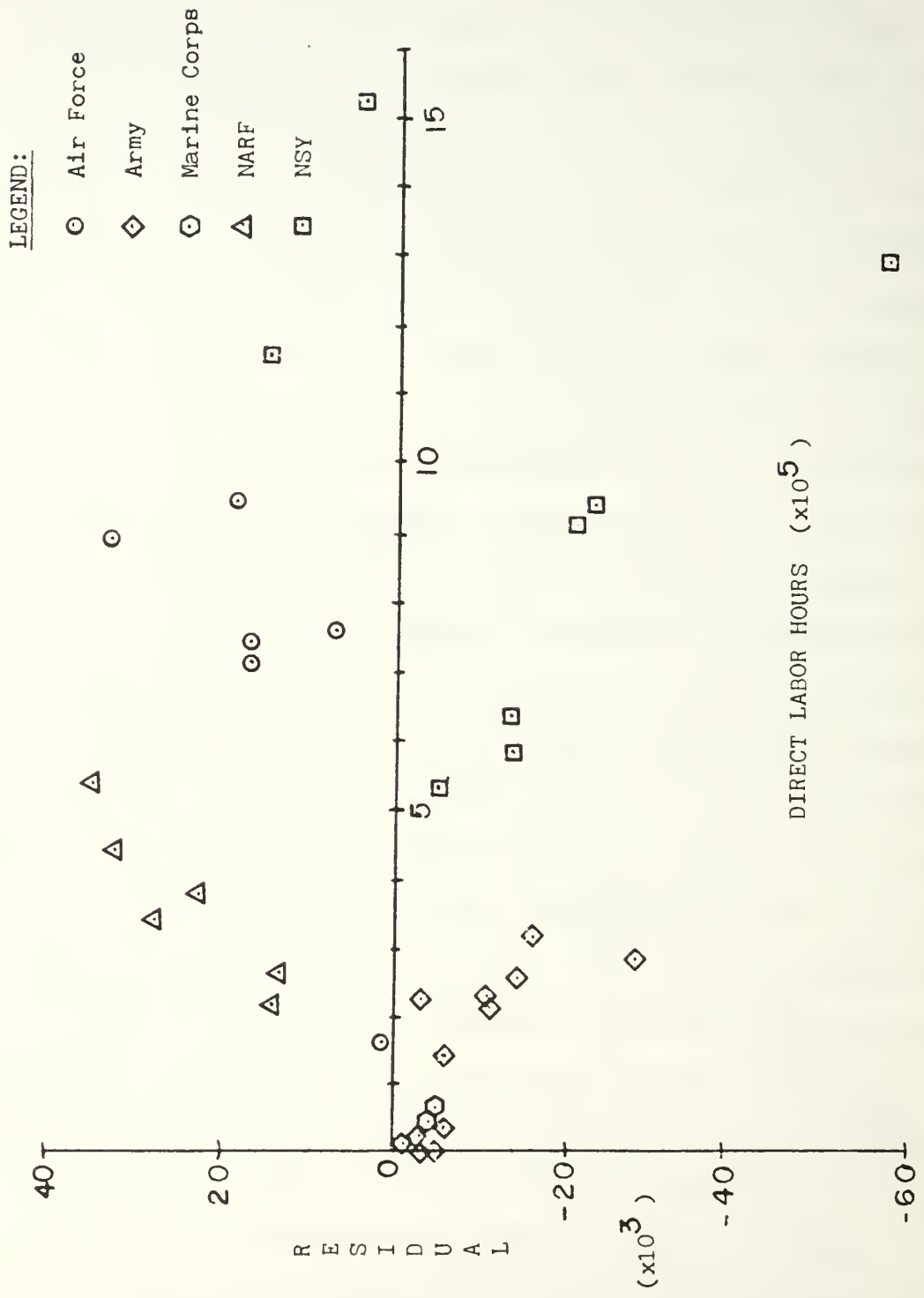

Figure 4.3: Residual Plot of FY83 Regression Data

In an attempt to adjust for regional costs, an adjustment factor was developed for the production indirect portion of overhead costs for each activity. G&A costs were not adjusted based on reasoning that the majority of such costs would be the labor costs of General Schedule civilian and military personnel. Such costs are not subject to regional price differentials. The adjustment factor used was the ratio of direct labor cost per hour for each activity to the average hourly direct labor cost for all depots. When linear regressions were performed using the adjusted overhead cost data, both the coefficient of determination and the standard error of the estimate were adversely effected. From this, it was tentatively concluded that regional cost differentials do not noticably impact comparisons of overhead cost since the adjustment should have enhanced the values. The rather fundamental approach to the identification of an adjustment factor was forced by available data. A more sophisticated analysis might provide different results.

Even considering that direct labor hours are only a surrogate for output and that caution must be exercised in analysis of results, the failure of the models in Figures 4.1, 2 and 3 to reflect economies and/or diseconomies of scale was unexpected. However, the residual plot for the Army depot group for FY83 (Figure 4.4) and the plot of the ratio of overhead costs to direct labor hours against depots in ascending order of direct labor hours (Figure 4.5) are suggestive of the expected relationship, at least for smaller activities. Given that the Army depots were excluded from the scope of this study, the impact of extremes in size of operation on comparability of overhead costs was not investigated further.

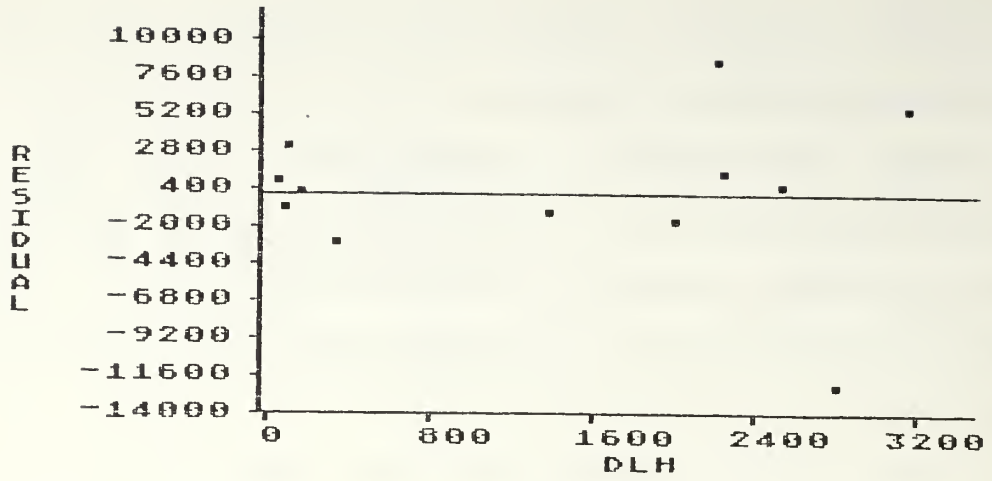

Figure 4.4: Residual Plot of Army Depots for FY83

3. Discussion

While the relationship identified between direct labor hours and overhead costs has been demonstrated, caution must be exercised in application, particularly as an efficiency measure. The use of direct labor hours, which is an input, as a surrogate for an output, common to all activities, can lead to anomalies and misinterpretation. For example, an increase in automation to improve efficiency would appear to reduce efficiency based on an increase in overhead cost per direct labor hour. In addition, the finding that a family of parallel lines is the more appropriate presentation complicates comparisons between activity groups.

The results from the linear regression model demonstrates that there is a characteristic relationship, as defined by the slope coefficient, between overhead costs and direct labor hours applicable to maintenance depots. It is also possible, but not supported by the current data, that there is a single characteristic relationship

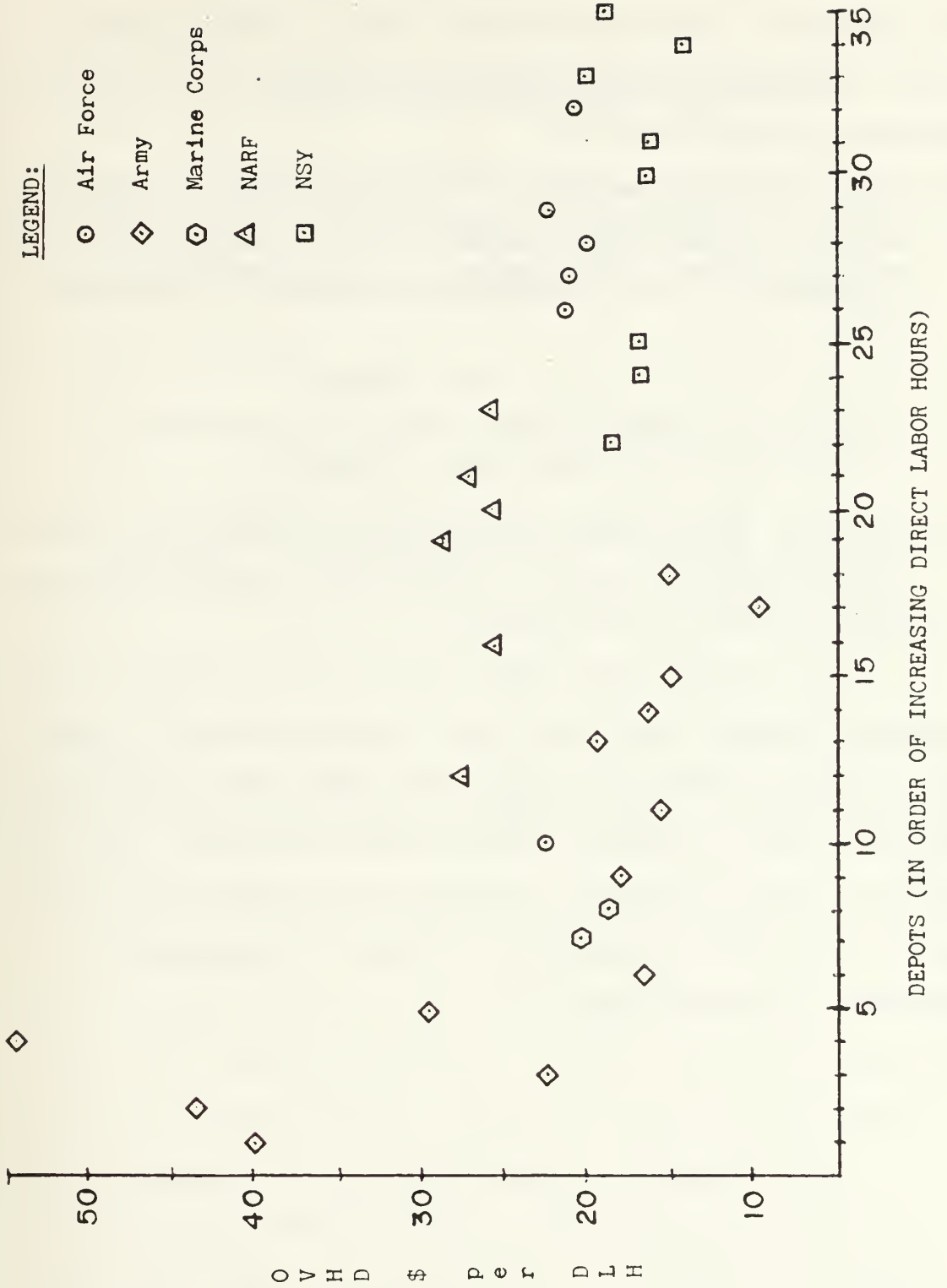

Figure 4.5: FY83 Overhead Cost per Direct Labor Hour by Depot

between overhead costs and direct labor. If such is the case, the vertical displacement of activity group lines would be the result of a combination of factors such as:

a. Lack of comparable data due to different treatments of overhead costs by activities and activity groups (i.e., supply support costs). This area was the subject of this research project. Based on analysis in this Chapter, it is concluded that the the variance induced is approximately 6 percent of total overhead costs.

b. The relative efficiency of a given activity.

c. Differences in prevailing rates for work occurring over an extended period of time such as at a shipyard.

d. Systematic differences in operational and administrative practices. Examples would include such items as degree of plant automation, degree of control exercised over overhead cost growth, selection of type of cost accounting system and degree of centralization and data automation.

Each of the above items could effect the cost relationships at an activity or group of activities. The data gathered for this study does not permit analysis of the last three items. What the analysis has shown is that the overhead cost data generated by the Air Force and Navy cost systems is comparable. Therefore, the analysis has provided evidence which permits elimination of a factor which could inhibit comparisons of depot efficiency.

V. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This final chapter presents conclusions, recommendations, and areas for further study. However, before discussing specific conclusions and recommendations, some general observations seem are presented.

A. GENERAL DISCUSSION

The objective of this research project was to investigate the handling of overhead costs by depot cost accounting systems and determine the degree of comparability between military services. Given resource constraints, the scope of the project was limited to investigation of only two of the Service's systems. It was planned to select divergent cost systems in order to ensure a contrast in the treatment of overhead costs. Given that the NARF job order cost system and Air Force Depot process cost system appeared to be among the more divergent, they were selected for study. NARF North Island and Ogden ALC were selected as the specific activities to be visited. The depots were chosen because of location and that they were not the major sites in the studies by Bernett (June 1984), Gorris (June 1984), and Tackett (June 1984). However, as a result of both site visits and review of pertinent published guidance, the similarities of the two systems became evident. The similarities found are described below.

In each case, DOD 7220.29H requirements had been integrated into the activity's cost and financial accounting systems. DOD 7220.29H data are extracted from the same data base used to generate

organizational and activity group financial and management reports. Given that the activity and activity group managers can ill afford a cost system which generates data not reflective of current operations, this finding raises the confidence in the data contained in the DOD Depot Maintenance data base.

Both systems have highly automated data collection and report generation capabilities for various management levels. Both systems maintain data integrity through a comprehensive system of checks on data input and an established set of procedures for error correction. However, the Air Force system is centrally controlled while the Navy system can be characterized as one with central policy and local implementation. The NALC effort to develop a standardized system (i.e., NIFMS - Navy) may eliminate some of these differences.

Both systems display sophisticated and comprehensive management systems at the activity and activity group level. The capabilities and timeliness of system feedback are such that the DOD 7220.29H data are of limited value at these levels, except as a supplement. The prime value of the overhead cost included in the data base is information for DOD staff for the analysis of relative cost structures across services. Therefore, comparability of resultant data, instead of uniformity of systems developing the data, appears the pertinent focus.

B. CONCLUSIONS AND RECOMMENDATIONS

DOD 7220.29H data are a good representation of the results of depot level maintenance actions at the two activities visited. However, comparison of the data without knowledge of the unique assumptions of

each system can lead to misinterpretation. In the strictest sense, the data are not comparable.

With regard to overhead costs, the scope of costs included and manner of treatment are similar for both systems. The single significant exception noted was the difference represented by material support costs which were less than 6.3 percent of total overhead costs. However, differences in classification of overhead costs as funded or unfunded and production indirect or G&A, as discussed in Chapter IV, precludes comparison by these sub-categories of overhead cost.

The analysis of data contained in Chapter IV supports comparison of activities within an activity group based on the linear relationship between total overhead costs and direct labor hours. Comparisons between activity groups can only be made based on the characteristic slope coefficient (i.e., ratio of overhead costs to direct labor hours). Analysis in Chapter IV supports a family of parallel lines by activity group rather than a single linear relationship. While current data do not support a single linear relationship for all depots, the support demonstrated for a family of parallel lines by activity group is suggestive that factors other than the scope and handling of cost data (i.e., the cost accounting system) impact on comparability of costs between activity groups and military services. Possibilities include the degree of production automation, degree of centralization and automation of overhead activities, and differing resource requirements to support selected operating methods. Based on the results of this study, regional cost differentials do not appear a potential factor.

Even the limited comparison based on overhead cost per direct labor hour could not be extended to Army Depots. The smaller size of the Army Depots compared to the activities studied suggest that the scale of operations may be one pertinent factor. However, additional data are required to permit any firm conclusions.

Within an activity group, the regression models used in Chapter IV, displayed in graphic form, has potential value as a supplement to information provided by the activity group management system. At the DOD level, comparisons can be made of the slope coefficients for each activity group. Whether used for comparison between military services or between activities in an activity group, the primary value should be in the identification of outliers for further investigation. Anomalies induced by the use of direct labor hours as a surrogate for a common output factor make any other use inadvisable.

Recommendation 1: That DOD eliminate separate reporting of production indirect and G&A overhead costs in Table 6 of the RCS DD-M(A) 1397 report. Total overhead costs and overhead cost per direct labor hour appear the more pertinent data and are less subject to misinterpretation. The requirement for separate reporting of production indirect and G&A should also be investigated. The separate data appears to have little value at the DOD level. This data are made available to pertinent activity and activity group management levels in a more timely manner by other existing management reporting systems.

Recommendation 2: That DOD develop, as part of the annual report, graphs depicting overhead cost versus direct labor hours and overhead cost per direct labor hour verses depots in ascending order of direct labor hours. The second graph appears particularly useful in depicting systematic differences by activity group and, over time may display any developing activity group trend.

Recommendation 3: NALC is currently involved in the development of a standardized accounting system for the NARFs. Capability to include unfunded material support costs should be investigated. While found to be of little consequence with regard to comparability of overhead cost data between the two Services, inclusion of military

administration costs and a standardized salvage value for depreciation would further reduce the variance between the two services with limited incremental effort required.

C. AREAS FOR ADDITIONAL RESEARCH

This research project has identified a linear relationship between overhead costs and direct labor hours within an activity group. In addition, the appropriateness of representing the relationship of overhead costs to direct labor hours between the NARF, ALC, and NSY activity groups as a family of parallel lines has been demonstrated. However, within activity groups, the individual data points for each activity display material divergence from the regression line. Also, the existence of a family of lines for activity groups is suggestive of a characteristic relationship applicable to all activity groups. In both cases, the variance suggests the existence of unidentified factors which blur the preciseness of the relationship. This project has identified the potential variance due to differences in cost accounting systems and regional prices, concluding they are not material. Further research as to the impact of the following factors that may potentially impact on comparability of overhead costs is required:

1. The degree of production automation employed at each activity has direct impact on the ratio of overhead costs to direct labor hours. Increased levels of automation requires increased capital expenditures, which are reflected in depreciation expense, and permits reduced production manning. Development of comparative data as to manyear equivalents of automation installed and related capital investment for depot activities is required to permit evaluation of the impact on comparability of cost data.

2. Site visits at the two activities revealed differences in organizational and operational philosophies. These differences, such as Job order versus process cost systems, centralized versus decentralized operation, and point of acceptance of overhauled aircraft (i.e., depot versus operating unit) have a potential

impact on resources required to support the depot maintenance function. Identification of the impact of these resource requirement differences will require detailed identification of the individual activities (i.e., cost accounting, management information systems, material expediting, aircraft delivery) at each depot and the the related resources (manpower, material) utilized in performance. Existence of significant automation may require use of manpower and cost equivalents to develop the comparison.

3. Differences in overhaul/repair duration can induce a variance in costs captured due to changes in the proportion of prior year costs included in reported data. While the NSY activity group was not investigated and any conclusion is premature, it is believed that this factor may provide partial explanation for the lower overhead cost per direct labor hour identified by this study. Quantification of the impact on comparability of costs between activities will require investigation of the magnitude of price differentials between years and the relative proportions of prior year costs in the annual DOD 7220.29H report for each activity.

Other research areas which were beyond the scope of the current study but are suggested by the results of the research include:

1. Analysis of Table 6 data in this study indicates that the Army depots operate at a characteristically lower overhead cost per direct labor hour. Investigation and comparison of the Army activity group with the others appears a productive area for further research.

2. While direct commercial counterparts to most public sector depots do not exist, investigation for a similar relationship as found in this study may prove fruitful with regard to comparison of public and private sector operation.

D. SUMMARY

In conclusion, this study explores comparability of overhead costs with regard to the scope and handling of included costs between Air Force depots and NARFs. Results of the study suggest that a characteristic relationship may exist between overhead costs and direct labor hours for public sector depots which has potential for evaluating relative efficiency (support required for level of productive effort) between activities and activity groups.

AFLC PREPARING ACTIVITY REPORTING REQUIREMENTS

Reports Control Symbol (RCS)	*Report Title*	*Prescribing Directive*	*AFLC OPR*	*Due Date*	*DISTRIBUTION*					
					USAF		*AFAFC*	*AFLC*		
					ACBORC	*LEY*	*TCRA*	*ACR*	*MAJ*	
LOG-ACF(M)7118	Analysis of DMS, AFIF Financial Status	AFLCR 170-10	ACFC	20CD					3	
LOG-ACF(M)7119	DM Operating Cost Report	AFLCR 170-10	ACFC	15CD					1	
HAF-ACF(M)7107	Trial Balance	AFM 170-21/ AFLCR 170-10	ACFC	15CD					1	(footnotes only)
HAF-ACF(M)7109 (OA)	Report of Selected Industrial Fund Data	AFM 170-21/ AFLCR 170-10	ACFC	25CD-3WD	1		2	1		
HAF-ACB(M)7114	Statement of Revenue and Expense Report	AFM 170-21	ACFC	28CD	2	1		1	2	
HAF-ACB(M)7114	Depot Maintenance Industrial Fund Financial Report	AFM 170-21	ACFC	28CD	2	1		1	2	
DD-COMP(AR)1307	Consolidated Trial Balance	AFM 170-21	ACFC	5CD of 2nd month (due out)			1			
DD-COMP(AR)1307	Post Closing Trial Balance	AFM 170-21/ AFLCR 170-10	ACFC	Note 1			1			

NOTE 1: Due dates established each year by AFR 170-9.

HQ AFLC REPORTING REQUIREMENTS

Reports Control Symbol (RCS)	*Report Title*	*Prescribing Directive*	*AFLC OPR*	*Due Date*	*Copies Distributed by Home Office To:*			
					USAF	*AFAFC*	*AFLC*	
					ACBORC	*TCRA*	*ACF*	*MAJ*
DD-COMP(AR)1092	Operating Budgets and Estimates	AFM 172-1/ AFLCR 170-10	ACR	AR	5		1	
DD-COMP(AR)1307	Industrial Fund Financial Statment	AFM 170-21/ AFLCR 170-10	ACFC		1	3	1	1
DD-I&L(A)1397	DM Cost and Production Report	AFR 177-7	ACFC	31 Dec		(See AFR 177-7)		
REPORTS RECEIVED BUT NOT PREPARED BY HQ AFLC								
HAF-ACF(M)7136	Industrial Fund Cash Data Report	AFM 170-21	ACFC					
HAF-ACF(M)7152 (DD)	Report of AEU (AFSC, Kirkland AFB)	AFM 177-120	ACFC					

APPENDIX B

MAINTENANCE MEANINGFUL MEASURES OF MERIT

I. PRODUCTION (Weight factor: .25); actual verses scheduled

   a. Aircraft (monthly by MDS)

   b. Exchangeable (quarterly)

   c. Engines (monthly by type/model)

   d. Modules (monthly by type/model)

   e. Gas Turbine Engines (monthly by type/model)

   f. Ground Electronics (monthly)

   g. Missiles (monthly)

II. QUALITY (Weight factor: .15); externally reported defects verses units produced and internally detected defects per unit of work with comparison against prior year period.

   a. Aircraft (monthly)

   b. Engine/Modules (monthly)

   c. Exchangables (monthly)

   d. Gas Turbine Engines (monthly)

   e. Missile (monthly)

   f. Ground Electronics (monthly)

III. MATERIAL (Weight factor: .10)

   a. Material Demand Support (monthly)

      1. Demand Support Rate

      2. Demand Accommodation

      3. Demand Satisfaction

b. AWP/G Assets (quarterly)

c. MIC Accuracy (monthly)

1. MIC Excess ($)

2. Inventory Adjustments ($)

IV. FINANCIAL MANAGEMENT (Weight factor: .10)

a. Net Operating Results (monthly)

b. Cost per Hour (monthly)

1. Labor

2. Material

3. Other

c. Sales (monthly)

1. Aircraft

2. Engines

3. Exchangables

4. Other

V. PRODUCTIVITY (Weight factor: .10)

a. Output per Paid Manday (monthly)

b. Savings/Cost Avoidance Value (quarterly)

1. Methods Improvement

2. Capital Investments

3. Output per Paid Manday

4. Quality of Worklife

5. Suggestions

6. Other

c. Labor Standards (monthly)

1. Accuracy

2. Progress (ie reductions)

3. Method Studies Complete

4. Coverage

VI. MANAGEMENT INFORMATION SYSTEMS (Weight factor: .10); under development.

VII. MANPOWER (Weight factor: .10); actual verses planned manpower

a. Program Execution (quarterly)

b. Direct Training (monthly)

VIII. EQUIPMENT/FACILITIES/TECHNOLOGY (Weight factor: .10)

a. Military Construction Program (quarterly)

1. Design Schedule

2. Design Period Funds

3. Construction Schedule

4. Construction Funds

5. Operational Schedule

b. Facility Maintenance and Repair (quarterly)

1. Design Schedule

2. Contract Award Schedule

3. Construction Schedule

4. Expense Rate

c. Minor Construction (quarterly)

1. Design Schedule

2. Contract Award Schedule

3. Construction Schedule

4. Obligation Rate

d. Equipment Program Obligation Rate (quarterly)

e. Process Energy (monthly)

f. Repair Technology (REPTECH) as required

1. Funding

2. Design and Development

3. Evaluate and Demonstrate

4. Depot Implementation

NOTE: Reports are tailored to the mission of each ALC. Therefore, each ALC only reports on those elements applicable.

APPENDIX C

COST CLASSIFICATION CODE DESCRIPTIONS

1263 COST CLASS CODE DESCRIPTIONS. Cost class codes and descriptions are as follows:

COST CLASS CODE	DESCRIPTION
AA	ADMINISTRATION - Except as noted below, this covers all costs incurred by the Commanding Officer, Executive Officer, Production Officer, Management Services Officer/Comptroller, Engineering and Quality Officer, Project and Program Officers, all supervisory personnel (exclusive of first level supervision in the Production Cost Centers) and all other personnel throughout the NAVAIREWORKFAC performing administration functions. GENERAL COST CENTERS - It is mandatory the Department Heads and Division Directors charge this account. Branch Heads and below will charge the appropriate Cost Class Code for the function being performed. PRODUCTION COST CENTERS - It is mandatory that Division Directors, Branch Heads, and Section Heads charge this account. First level supervision will be charged to Cost Class Code MA - Shop Supervision. EXCEPTIONS: (1) Man-hours and cost of all supervisors, while performing functions directly related to funded special projects, including NEPSO (Naval Engineering Support Program), will be charged to the applicable direct job order number. (2) Labor costs while undergoing off-station training will be charged to Cost Class Code NC - Training - Other (3) All costs of per diem and travel expense incurred while in a travel-training status will be charged to Cost Class Code PB(Travel Training). (4) All Costs incurred while performing temporary duties off-station to investigate discrimination cases will be charged to Cost Class Code QC (Investigating Officers) (J.O. #7Z1QC00).
AB	GENERAL OFFICE SERVICES - All costs associated with general office services functions required by the NAVAIREWORKFAC, such as mail and file, travel orders, and messenger services.
AC	PRINTING AND DUPLICATING - All costs incurred for printing and duplicating.

COST CLASS CODE	DESCRIPTION
AD	CIVILIAN PERSONNEL SERVICES - All costs incurred within the NAVAIREWORKFAC for civilian personnel services, including manpower management, grading of 171's etc. - must be in excess of two hours.
AE	SECURITY - All cost incurred for plant police and other security personnel on the NAVAIREWORKFAC payroll and any supplies required in support thereof.
AF	SAFETY SUPPLIES AND SERVICES - Includes the cost of personnel engaged in the safety program and safety supplies such as protective clothing, goggles, face shields, hard hats, toe shields and other safety devices which are not classified as plant property, and eye examinations when not performed by on-station personnel.
AG	POSITION MANAGEMENT PROGRAM - All cost incurred in executing the position management program, including processing of position management actions.
AH	PAPERWORK MANAGEMENT PROGRAM - All costs incurred in executing the paperwork management program, including the development, control and maintenance of forms, reports, and records.
AJ	FACILITY DIRECTIVES PROGRAM - All costs of administering the preparation, edition, and publishing of formal management directives on the various phases of NAVAIREWORKFAC organization operations, and policies.
AK	CIVILIAN MANPOWER MANAGEMENT - CONTRACTUAL - All costs incurred for civilian personnel service support received from the Host Air Station or other outside sources.
AL	SECURITY - CONTRACTUAL - All costs incurred for security support received from the Host Air Station or other outside source.
AM	SAFETY - CONTRACTUAL - All costs incurred for safety program support received from the Host Air Station or other outside source.
AN	PUBLIC AFFAIRS - CONTRACTUAL - All costs incurred for public affairs support received from the Host Air Station or other outside source.
AP	COMMUNICATIONS - CONTRACTUAL - All costs incurred for communications support received for the Host Air Station or other outside source.
AQ	FREEDOM OF INFORMATION ACT COSTS - for costs incurred in the process of responding to requests from the public for records and information under the Freedom of Information Act and/or appropriate NAVAIRINST.

COST CLASS CODE	DESCRIPTION
AR	FREEDOM OF INFORMATION ACT COLLECTIONS RECEIVED - For fees collected in accordance with NAVAIRINST 7040.12 and/or applicable NAVAIRINST.
AS	EMPLOYEE LABOR RELATIONS ADMINISTRATION - All costs incurred by Civilian Personnel Office personnel in labor relations such as negotiating agreements, representing facility before third party proceedings, interpreting, and developing agreement language.
AT	APPEALS AND GRIEVANCES ADMINISTRATION - All costs incurred in processing employee appeals and grievances to include investigation of these appeals and grievances.
AU	EMPLOYEE SERVICES ADMINISTRATION - All costs incurred in the administration of performance ratings, retirement, health benefits, and life insurance programs.
AV	INCENTIVE AWARDS ADMINISTRATION - All costs incurred in the administration of an incentive awards program.
AW	TRAINING ADMINISTRATION (NONAPPRENTICE) - All costs incurred in the administration of nonapprentice training programs.
AX	TRAINING ADMINISTRATION (APPRENTICE) - All costs incurred in the administration of apprentice training program.
AY	EMPLOYMENT STAFFING ADMINISTRATION - All costs incurred to develop and administer the Employment and Merit Promotion Program. To include processing personnel actions, recruiting, testing, and developing qualification standards.
BA	MANAGEMENT SYSTEMS DESIGN AND DEVELOPMENT - Local costs incurred in the design, development, maintenance, and operation of management systems and procedures for that portion of the management information system which is not designed and maintained by the Management Systems Development Directive (MSDD). Included in the maintenance of manual systems.
BC	MIS FOR INAS OPERATION - Costs incurred in the effort required to manage the inputs, outputs, and processes required in the operation of that part of the management information system designed and maintained by MSDD. Included are the coordination efforts with the MSDD, the Data Processing Department (DPD) or Service Center (DPSC), NARDACS and the in-house users.

COST CLASS CODE	DESCRIPTION
BD	DATA PROCESSING EQUIPMENT LEASE AND OPERATIONS - In-House costs incurred by the NAVAIREWORKFAC which fall within the purview of the Navy Automatic Data Processing Program Reporting System (ADPPRS). Included are the lease and contract maintenance cost of ADPPRS reportable Remote Job Entry (RJE) and Source Data Automation (SDA) equipment which is physically located within the NAVAIREWORKFACs, salaries of ADPPRS reportable equipment operators employed by the NAVAIREWORKFAC, and cost of ADPPRS reportable NAVAIREWORKFAC held supplies.
BE	MANAGEMENT INFORMATION SYSTEMS, OTHER EXPENSE - Costs incurred internal to the NAVAIREWORKFACs which don't fall within the definitions of Codes BA, BB, BC, and BD above.
BF	SYSTEMS DESIGN, ANALYSIS, AND PROGRAMMING - CONTRACT AND REIMBURSABLE - Contractual or reimbursable costs incurred by the NAVAIREWORKFACs for services rendered by Government reimbursable or private sector contract sources in the design, development, and maintenance of computerized management information systems. This code is restricted to costs related to systems other than the systems designed and maintained by the Management Systems Development Directive (MSDD).
BG	SYSTEMS MAINTENANCE - CONTRACTUAL AND REIMBURSABLE - Costs incurred by the NAVAIREWORKFACs for services rendered by Air Station Data Processing Departments (DPDs) or Service Centers (DPSCs) or NARDACs for operationally maintaining MSDD designed and maintained systems.
BH	ADP TIME AND RELATED SERVICES - CONTRACT AND REIMBURSABLE - Costs of ADP equipment utilization time and computer operators salaries (not including source data entry) charged to the NAVAIREWORKFAC by the DPDs or DPSCs or NARDACs.
BJ	ADP ADMINISTRATION - REIMBURSABLE - Cost incurred in the administration of ADP services charged to the NAVAIREWORKFAC by the DPDs or DPSCs or NARDACs.
BK	DATA PROCESSING - OTHER - All other ADPPRs reportable costs which are not covered by code BA through BJ above.
BL	KEYPUNCH AND OTHER SOURCE DATA ENTRY - CONTRACTOR AND REIMBURSABLE - Costs of entering programs or data onto a machine readable medium charged to the NAVAIREWORKFACs by the DODs or DOSCs or NARDACs or in rare cases by private sector contractors.

APPENDIX D

ALLOCATED REIMBURSABLE SUPPORT

I. AIR OPERATIONS

a. Structural fire (excluding NARF direct)

b. A/C live and rescue

c. A/C control

d. Material

e. Class A and C telephone lines

f. CO2 units

II. INDUSTRIAL RELATIONS

a. Labor (excluding NARF direct)

b. Safety

c. Material

III. SUPPLY

a. Property Branch labor

b. Fuel Farm

IV. SECURITY

a. Base security

V. COMPTROLLER

a. Payroll

b. ADP services

VI. DATA PROCESSING

a. Machine rates

b. Programmer/analysts

VII. COMMUNICATIONS

a. Message traffic

VIII. ELEVATOR INSPECTION

APPENDIX E

FY79 TO FY82 LINEAR REGRESSION CURVES

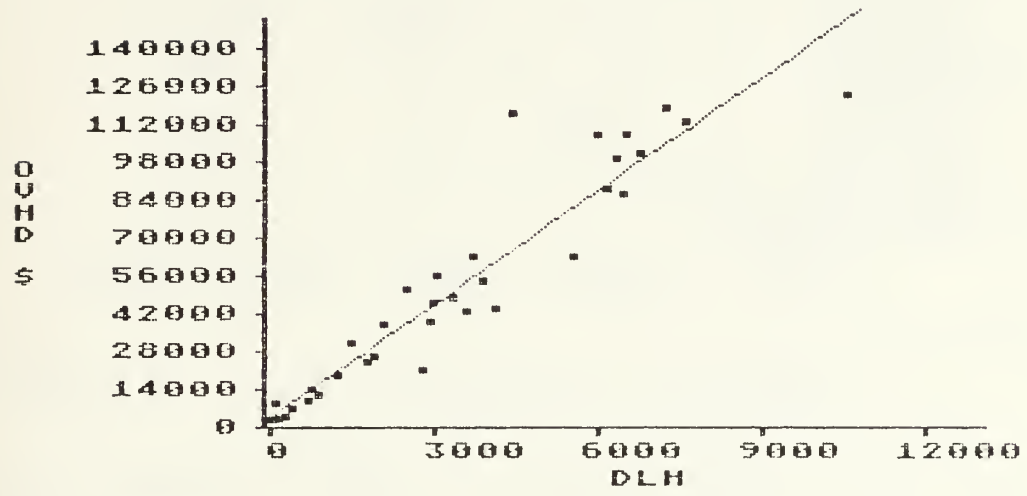

Figure E.1: FY79 Regression Curve

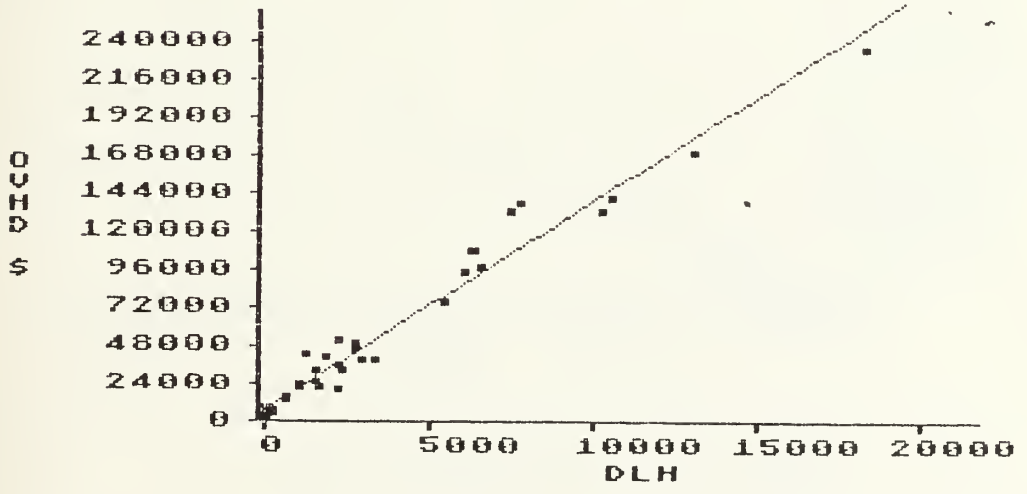

Figure E.2: FY80 Regression Curve

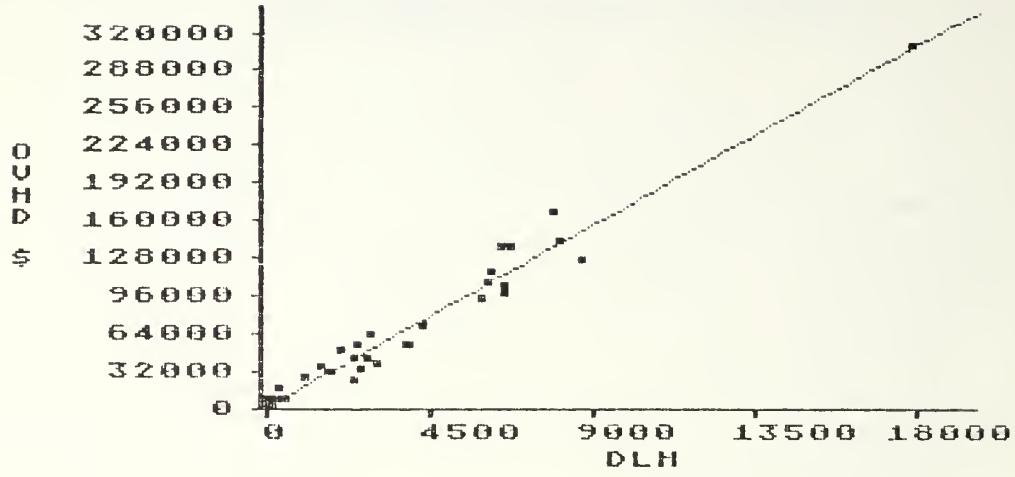

Figure E.3: FY81 Regression Curve

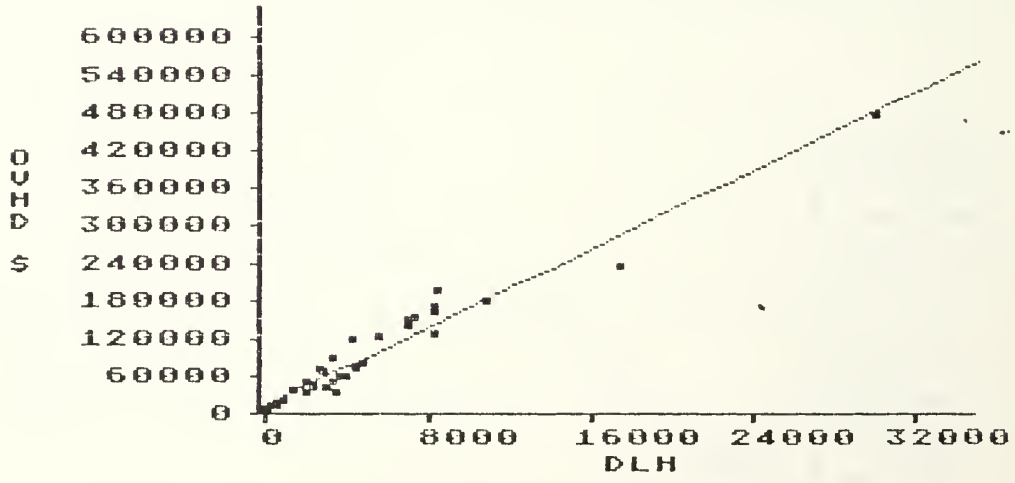

Figure E.4: FY82 Regression Curve

APPENDIX F

SUMMARY OF TEST OF LINEAR SLOPE COEFFICIENTS

A. ACTIVITY DATA

Activity	$(x-\bar{x})$ x10^8	SSE x10^8	n	b
NARFs	.0670	.7334	6	25.674
NSYs	.8965	32.134	8	18.358
ALCs	.3851	2.7699	6	21.406

B. PAIRED DATA

Pair	SSE(F) x10^8	SSE(R) x10^8	$s(b_1-b_2)$	(b_1-b_2)	l *	u *
NARF/ALC	3.5035	11.721	7.6706	4.2680	- 13.42	21.956
ALC/NSY	34.9035	67.177	12.957	3.048	- 25.82	31.965
NARF/NSY	32.8674	67.557	52.704	7.316	-110.11	124.741

* The limits, l and u, define a 95 percent confidence interval for the difference between the two coefficients; as zero is included in all cases, the hypothesis that the slope coefficients are the same cannot be rejected at the 0.05 level of confidence.

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